Cochrane Library

Cochrane Database of Systematic Reviews

Pulmonary rehabilitation for chronic obstructive pulmonary disease (Review)

McCarthy B, Casey D, Devane D, Murphy K, Murphy E, Lacasse Y

McCarthy B, Casey D, Devane D, Murphy K, Murphy E, Lacasse Y.
Pulmonary rehabilitation for chronic obstructive pulmonary disease.
Cochrane Database of Systematic Reviews 2015, Issue 2. Art. No.: CD003793.
DOI: 10.1002/14651858.CD003793.pub3.

www.cochranelibrary.com

WILEY

TABLE OF CONTENTS

ABSTRACT 1
PLAIN LANGUAGE SUMMARY 2
SUMMARY OF FINDINGS 3
BACKGROUND 5
OBJECTIVES 6
METHODS 6
Figure 1. 9
Figure 2. 10
RESULTS 11
Figure 3. 12
Figure 4. 14
Figure 5. 16
DISCUSSION 19
AUTHORS' CONCLUSIONS 20
ACKNOWLEDGEMENTS 21
REFERENCES 22
CHARACTERISTICS OF STUDIES 42
DATA AND ANALYSES 142
Analysis 1.1. Comparison 1 Rehabilitation versus usual care, Outcome 1 QoL - Change in CRQ (Fatigue). 143
Analysis 1.2. Comparison 1 Rehabilitation versus usual care, Outcome 2 QoL - Change in CRQ (Emotional Function). 143
Analysis 1.3. Comparison 1 Rehabilitation versus usual care, Outcome 3 QoL - Change in CRQ (Mastery). 144
Analysis 1.4. Comparison 1 Rehabilitation versus usual care, Outcome 4 QoL - Change in CRQ (Dyspnoea). 144
Analysis 1.5. Comparison 1 Rehabilitation versus usual care, Outcome 5 QoL - Change in SGRQ (Total). 145
Analysis 1.6. Comparison 1 Rehabilitation versus usual care, Outcome 6 QoL - Change in SGRQ (Symptoms). 146
Analysis 1.7. Comparison 1 Rehabilitation versus usual care, Outcome 7 QoL - Change in SGRQ (Impacts). 146
Analysis 1.8. Comparison 1 Rehabilitation versus usual care, Outcome 8 QoL - Change in SGRQ (Activity). 147
Analysis 1.9. Comparison 1 Rehabilitation versus usual care, Outcome 9 Maximal Exercise (Incremental shuttle walk test). 147
Analysis 1.10. Comparison 1 Rehabilitation versus usual care, Outcome 10 Maximal Exercise Capacity (cycle ergometer). 148
Analysis 1.11. Comparison 1 Rehabilitation versus usual care, Outcome 11 Functional Exercise Capacity (6MWT)). 148
Analysis 2.1. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 1 QoL - Change in CRQ (Fatigue). 151
Analysis 2.2. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 2 QoL - Change in CRQ (Emotional Function). 152
Analysis 2.3. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 3 QoL - Change in CRQ (Mastery). 152
Analysis 2.4. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 4 QoL - Change in CRQ (Dyspnoea). 153
Analysis 2.5. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 5 QoL - Change in SGRQ (Total). 154
Analysis 2.6. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 6 QoL - Change in SGRQ (Symptoms). 155
Analysis 2.7. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 7 QoL - Change in SGRQ (Impacts). 156
Analysis 2.8. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 8 QoL - Change in SGRQ (Activity). 156
Analysis 3.1. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 1 QoL - Change in CRQ (Fatigue). 159
Analysis 3.2. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 2 QoL - Change in CRQ (Emotional Function). 160
Analysis 3.3. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 3 QoL - Change in CRQ (Mastery). 160
Analysis 3.4. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 4 QoL - Change in CRQ (Dyspnoea). 161

Analysis 3.5. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 5 QoL - Change in SGRQ (Total). 162
Analysis 3.6. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 6 QoL - Change in SGRQ (Symptoms). 163
Analysis 3.7. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 7 QoL - Change in SGRQ (Impacts). 164
Analysis 3.8. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 8 QoL - Change in SGRQ (Activity). 164
Analysis 4.1. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 1 QoL - Change in CRQ (Dyspnoea). 166
Analysis 4.2. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 2 QoL - Change in CRQ (Emotional Function). 166
Analysis 4.3. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 3 QoL - Low Risk CRQ (Fatigue). 167
Analysis 4.4. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 4 QoL - Low Risk CRQ (Mastery). 167
Analysis 4.5. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 5 QoL - Low Risk SGRQ (Total). 168
Analysis 4.6. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 6 QoL - Low Risk SGRQ (Symptoms). 168
Analysis 4.7. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 7 QoL - Low Risk SGRQ (Impacts). 168
Analysis 4.8. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 8 QoL - Low Risk SGRQ (Activity). 169
ADDITIONAL TABLES 169
APPENDICES 179
WHAT'S NEW 184
HISTORY 184
CONTRIBUTIONS OF AUTHORS 184
DECLARATIONS OF INTEREST 184
DIFFERENCES BETWEEN PROTOCOL AND REVIEW 185
INDEX TERMS 185

[Intervention Review]

Pulmonary rehabilitation for chronic obstructive pulmonary disease

Bernard McCarthy[1], Dympna Casey[1], Declan Devane[1], Kathy Murphy[1], Edel Murphy[1], Yves Lacasse[2]

[1]School of Nursing and Midwifery, National University of Ireland Galway, Galway, Ireland. [2]Institut Universitaire de Cardiologie et de Pneumologie de Québec, Université Laval, Québec, Canada

Contact: Bernard McCarthy, School of Nursing and Midwifery, National University of Ireland Galway, Aras Moyola, Galway, Co. Galway, Ireland. Bernard.mccarthy@nuigalway.ie.

Editorial group: Cochrane Airways Group.
Publication status and date: Edited (no change to conclusions), published in Issue 4, 2015.

Citation: McCarthy B, Casey D, Devane D, Murphy K, Murphy E, Lacasse Y. Pulmonary rehabilitation for chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews* 2015, Issue 2. Art. No.: CD003793. DOI: 10.1002/14651858.CD003793.pub3.

ABSTRACT

Background

Widespread application of pulmonary rehabilitation (also known as respiratory rehabilitation) in chronic obstructive pulmonary disease (COPD) should be preceded by demonstrable improvements in function (health-related quality of life, functional and maximal exercise capacity) attributable to the programmes. This review updates the review reported in 2006.

Objectives

To compare the effects of pulmonary rehabilitation versus usual care on health-related quality of life and functional and maximal exercise capacity in persons with COPD.

Search methods

We identified additional randomised controlled trials (RCTs) from the Cochrane Airways Group Specialised Register. Searches were current as of March 2014.

Selection criteria

We selected RCTs of pulmonary rehabilitation in patients with COPD in which health-related quality of life (HRQoL) and/or functional (FEC) or maximal (MEC) exercise capacity were measured. We defined 'pulmonary rehabilitation' as exercise training for at least four weeks with or without education and/or psychological support. We defined 'usual care' as conventional care in which the control group was not given education or any form of additional intervention. We considered participants in the following situations to be in receipt of usual care: only verbal advice was given without additional education; and medication was altered or optimised to what was considered best practice at the start of the trial for **all** participants.

Data collection and analysis

We calculated mean differences (MDs) using a random-effects model. We requested missing data from the authors of the primary study. We used standard methods as recommended by The Cochrane Collaboration.

Main results

Along with the 31 RCTs included in the previous version (2006), we included 34 additional RCTs in this update, resulting in a total of 65 RCTs involving 3822 participants for inclusion in the meta-analysis.

We noted no significant demographic differences at baseline between members of the intervention group and those who received usual care. For the pulmonary rehabilitation group, the mean forced expiratory volume at one second (FEV_1) was 39.2% predicted, and for the usual care group 36.4%; mean age was 62.4 years and 62.5 years, respectively. The gender mix in both groups was around two males for

each female. A total of 41 of the pulmonary rehabilitation programmes were hospital based (inpatient or outpatient), 23 were community based (at community centres or in individual homes) and one study had both a hospital component and a community component. Most programmes were of 12 weeks' or eight weeks' duration with an overall range of four weeks to 52 weeks.

The nature of the intervention made it impossible for investigators to blind participants or those delivering the programme. In addition, it was unclear from most early studies whether allocation concealment was undertaken; along with the high attrition rates reported by several studies, this impacted the overall risk of bias.

We found statistically significant improvement for all included outcomes. In four important domains of quality of life (QoL) (Chronic Respiratory Questionnaire (CRQ) scores for dyspnoea, fatigue, emotional function and mastery), the effect was larger than the minimal clinically important difference (MCID) of 0.5 units (dyspnoea: MD 0.79, 95% confidence interval (CI) 0.56 to 1.03; N = 1283; studies = 19; moderate-quality evidence; fatigue: MD 0.68, 95% CI 0.45 to 0.92; N = 1291; studies = 19; low-quality evidence; emotional function: MD 0.56, 95% CI 0.34 to 0.78; N = 1291; studies = 19; mastery: MD 0.71, 95% CI 0.47 to 0.95; N = 1212; studies = 19; low-quality evidence). Statistically significant improvements were noted in all domains of the St. George's Respiratory Questionnaire (SGRQ), and improvement in total score was better than 4 units (MD -6.89, 95% CI -9.26 to -4.52; N = 1146; studies = 19; low-quality evidence). Sensitivity analysis using the trials at lower risk of bias yielded a similar estimate of the treatment effect (MD -5.15, 95% CI -7.95 to -2.36; N = 572; studies = 7).

Both functional exercise and maximal exercise showed statistically significant improvement. Researchers reported an increase in maximal exercise capacity (mean Wmax (W)) in participants allocated to pulmonary rehabilitation compared with usual care (MD 6.77, 95% CI 1.89 to 11.65; N = 779; studies = 16). The common effect size exceeded the MCID (4 watts) proposed by Puhan 2011(b). In relation to functional exercise capacity, the six-minute walk distance mean treatment effect was greater than the threshold of clinical significance (MD 43.93, 95% CI 32.64 to 55.21; participants = 1879; studies = 38).

The subgroup analysis, which compared hospital-based programmes versus community-based programmes, provided evidence of a significant difference in treatment effect between subgroups for all domains of the CRQ, with higher mean values, on average, in the hospital-based pulmonary rehabilitation group than in the community-based group. The SGRQ did not reveal this difference. Subgroup analysis performed to look at the complexity of the pulmonary rehabilitation programme provided no evidence of a significant difference in treatment effect between subgroups that received exercise only and those that received exercise combined with more complex interventions. However, both subgroup analyses could be confounded and should be interpreted with caution.

Authors' conclusions

Pulmonary rehabilitation relieves dyspnoea and fatigue, improves emotional function and enhances the sense of control that individuals have over their condition. These improvements are moderately large and clinically significant. Rehabilitation serves as an important component of the management of COPD and is beneficial in improving health-related quality of life and exercise capacity. It is our opinion that additional RCTs comparing pulmonary rehabilitation and conventional care in COPD are not warranted. Future research studies should focus on identifying which components of pulmonary rehabilitation are essential, its ideal length and location, the degree of supervision and intensity of training required and how long treatment effects persist. This endeavour is important in the light of the new subgroup analysis, which showed a difference in treatment effect on the CRQ between hospital-based and community-based programmes but no difference between exercise only and more complex pulmonary rehabilitation programmes.

PLAIN LANGUAGE SUMMARY

Pulmonary rehabilitation for chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD) describes a chronic lung condition that prevents the air supply from getting to the lungs. Symptoms include breathlessness, coughing, tiredness and frequent chest infection. Worldwide, COPD is a major cause of ill health.

Pulmonary rehabilitation programmes include exercise as a key component; some programmes contain other interventions such as assessment, education, psychological support and dietary advice. Pulmonary rehabilitation is one of the key recommended approaches in the treatment of COPD. This review compared the impact of pulmonary rehabilitation versus usual care on the health-related quality of life of people with COPD. We included 65 studies involving 3822 participants. Participants were randomly assigned to receive pulmonary rehabilitation or usual care. The quality of the studies was generally good.

This review highlights that pulmonary rehabilitation improves the health-related quality of life of people with COPD. Results strongly support inclusion of pulmonary rehabilitation as part of the management and treatment of patients with COPD.

Future studies should concentrate on identifying the most important components of pulmonary rehabilitation, the ideal length of a programme, the intensity of training required and how long the benefits of the programme last.

Summary of findings for the main comparison. Rehabilitation versus usual care for chronic obstructive pulmonary disease

Rehabilitation versus usual care for chronic obstructive pulmonary disease

Patient or population: patients with chronic obstructive pulmonary disease
Settings: hospital and community
Intervention: rehabilitation versus usual care

Outcomes	Illustrative comparative effects* (95% CI)		Number of participants (studies)	Quality of the evidence (GRADE)	Comments
	Response on control	Treatment effect			
	Usual care	Rehabilitation versus usual care			
QoL - Change in CRQ (dyspnoea) CRQ Questionnaire. Scale from 1 to 7 (Higher is better and 0.5 unit is an important difference) Follow-up: median 12 weeks	Median change = 0 units	Mean QoL - change in CRQ (Dyspnoea) in the intervention groups was **0.79 units higher** (0.56 to 1.03 higher)	1283 (19 studies)	⊕⊕⊕⊖ **Moderate** [1,2,3]	Sensitivity analysis from studies at lower risk of bias was similar (MD 0.99, 95% CI 0.64 to 1.34; participants = 384; studies = 5; I^2 = 34%)
QoL - Change in SGRQ (total) Scale from 0 to 100 (Lower is better and 4 units is an important difference) Follow-up: median 12 weeks	Median change = 0.42 units	Mean QOL - change in SGRQ (total) in the intervention groups was **6.89 units lower** (9.26 to 4.52 lower)	1146 (19 studies)	⊕⊕⊕⊖ **Moderate** [2,3,4]	Sensitivity analysis from studies at lower risk of bias was similar (MD -5.15, 95% CI -7.95 to -2.36; participants = 572; studies = 7; I^2 = 51%)
Change in maximal exercise (Incremental Shuttle walk test (ISWT)) Distance metres Follow-up: median 12 weeks	Median change = 1 metre	Mean maximal exercise (incremental shuttle walk test) in the intervention groups was **39.77 metres higher** (22.38 to 57.15 higher)	694 (8 studies)	⊕⊕⊕⊖ **Moderate** [2,3,5]	
Change in functional exercise capacity (6MWT)) Distance metres Follow-up: median 12 weeks	Median change = 3.4 metres	Mean functional exercise capacity (6MWT)) in the intervention groups was **43.93 metres higher** (32.64 to 55.21 higher)	1879 (38 studies)	⊕⊖⊖⊖ **Very low** [2,3,6,7]	

Change in maximal exercise capacity (cycle ergometer) Workmax (watt) Follow-up: median 12 weeks	Median change = -0.05 watts	Mean maximal exercise capacity (cycle ergometer) in the intervention groups was **6.77 watts higher** (1.89 to 11.65 higher)	779 (16 studies)	⊕⊕⊖⊖ **Low** [2,3,8,9]

*The basis for the response on control is the median control group response across studies.
CI: confidence interval; MD: mean difference.

GRADE Working Group grades of evidence.
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

[1]17 studies reported random sequence generation (1 unclear), 12 reported allocation concealment 2 did not have allocation concealment and it is unclear in 5 studies. 4 studies did not blind assessors, 11 blinded assessors and 4 were unclear as to assessor blinding. 6 studies had attrition bias greater than 20%.

[2]Downgraded as there is a high level of heterogeneity within the results. Several factors may impact heterogeneity, including content of the intervention programme, setting of the programme and severity of COPD.

[3]Greater than optimal Information size (OIS). 95% confidence interval does not includes "no effect," nor does the confidence limit cross the MID, so no need to downgrade.

[4]18 studies reported random sequence generation (2 unclear), 10 reported allocation concealment, 2 did not have allocation concealment and it is unclear in 7 studies. 3 studies did not blind assessors, 9 blinded assessors and 7 were unclear as to assessor blinding. 7 studies had attrition bias greater than 20%.

[5]All 8 studies reported random sequence generation, 5 reported allocation concealment and it is unclear in 3 studies. 5 studies had blind assessors with 1 not blinded, and 2 were unclear as to assessor blinding. 4 studies had attrition bias greater than 20%.

[6]34 studies reported random sequence generation, 4 were unclear, 20 reported allocation concealment, 3 did not have allocation concealment and it is unclear in 15 studies. 5 studies did not blind assessors, 19 blinded assessors and 13 were unclear as to assessor blinding. 13 studies had attrition bias greater than 20% and 2 were unclear.

[7]Downgraded as bias indicated for 6-minute walk test: Egger: bias = 1.24304 (95% CI = 0.183967 to 2.302131; P value 0.0227). Begg-Mazumdar: Kendall's tau = 0.16074 (P value 0.1601).

[8]All 16 studies reported random sequence generation, 6 reported allocation concealment, 3 did not have allocation concealment and it is unclear in 7 studies. 2 studies did not blind assessors, 10 blinded assessors and 4 were unclear as to assessor blinding. 4 studies had attrition bias greater than 20%.

[9]Downgraded as bias indicated for cycle ergometer test: Egger: bias = 1.57164 (95% CI = 0.6053 to 2.337984; P value 0.0036). Begg-Mazumdar: Kendall's tau = -0.2666667 (P value 0.139).

BACKGROUND

Description of the condition

Chronic obstructive pulmonary disease (COPD) is a multi-factorial progressive chronic lung disease that causes obstruction in airflow. This obstruction results in persistent and progressive breathlessness, productive coughing, fatigue and recurrent chest infection (GOLD 2014). COPD is also associated with extrapulmonary effects such as muscle wasting, osteopaenia (reduction in protein and mineral content of bone tissue), cardiovascular disease and depression and therefore is now best understood as a systemic disease (Agusti 2003; Agusti 2005). Worldwide, COPD is a major cause of morbidity. It is estimated that 210 million people are living with COPD (Franchi 2009), and it is projected that by the year 2030, COPD will be the third most frequent cause of death globally (WHO 2008). At this time, COPD is an incurable condition that is associated with significant economic costs due to progressive disease severity and frequent hospital admissions and readmissions (GOLD 2014; Guarascio 2013).

Risk factors for COPD are numerous and include genetics, recurrent respiratory infection, low socioeconomic status, exposure to air pollutants, poor nutrition and asthma (Eisner 2010; GOLD 2014). However smoking is recognised as a major cause of COPD, and the more a person smokes, the more likely he or she is to develop this condition (Forey 2011).

COPD is a heterogeneous condition with marked variation in progression between individuals (Casanova 2011; Nishimura 2013). The initial underlying pathology of COPD is confined to the lungs, and a clinical diagnosis is based on presenting symptoms and confirmation of airflow obstruction with a postbronchodilator spirometry forced expiratory volume in one second/forced vital capacity ratio (FEV_1/FVC) < 0.70 (GOLD 2014). The Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines are usually used to grade the severity of airflow limitations as mild ($FEV_1 \geq 80\%$ predicted: GOLD 1), moderate ($50\% \leq FEV_1 < 80\%$ predicted: GOLD 2), severe ($30\% \leq FEV_1$ 50% predicted: GOLD 3) or very severe (FEV_1 < 30% predicted: GOLD 4) (GOLD 2014).

The symptoms of COPD make engagement in physical activity unpleasant as the result of air trapping and increased hyperinflation in the lungs, which result in increased breathlessness due to subsequent inefficient breathing (O' Donnell 2007). Increased breathlessness provokes anxiety, which inevitably leads to further breathlessness, exacerbation of COPD symptoms and panic. This causes a vicious circle whereby any activities that involve physical exertion are avoided, causing muscle de-conditioning, which further reduces capacity to engage in physical activity (Bourbeau 2007). Physical inactivity is therefore a key predictor of mortality in people with COPD (Garcia-Aymerich 2006; Spruit 2013; Waschki 2011). Consequently, the joint American Thoracic Society and European Respiratory Society (ATS/ERS) (Spruit 2013) guidelines highlight the importance of exercise in the treatment and management of COPD.

Description of the intervention

Treatment interventions for COPD include smoking cessation, pharmacological and non-pharmacological therapies and, in specific circumstances, supplemental oxygen, ventilatory support, surgical treatment and palliative care (GOLD 2014). However, best evidence and all current international guidelines ratify the central role of pulmonary rehabilitation in the treatment of people with COPD (GOLD 2014; NICE 2010; Nici 2006; Ries 2007; Spruit 2013).

Pulmonary rehabilitation (PR), which was first defined by the American College of Chest Physicians Committee in 1974, is a proactive approach to minimising COPD symptoms, improving health-related quality of life (HRQoL) and increasing physical and emotional involvement in everyday life (GOLD 2014; Nici 2006; Ries 2007). The ATS in conjunction with the ERS has published numerous comprehensive statements on PR, with the most recent update in 2013. In the latest update, pulmonary rehabilitation was defined newly as a "…comprehensive intervention based on a thorough patient assessment followed by patient tailored therapies that include, but are not limited to, exercise training, education, and behaviour change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviours" (Spruit 2013). This new definition differs from the previous one (2006) in that it focuses on the interdisciplinary and therefore more holistic approach to PR rather than on the previous multi-disciplinary approach; highlights the importance of behaviour change; and places PR firmly within the concept of integrated care (Spruit 2013).

Depending on culture, healthcare systems and resources, the structure, personnel, content and settings of PR programmes may vary (Nici 2006; Spruit 2013). However, individually tailored exercise training is considered the cornerstone of PR (Nici 2006; Ries 2007; Spruit 2013). In particular, strength, low- and high-intensity training, exercise endurance and upper and lower extremity training are recommended (Nici 2006; Ries 2007, Spruit 2013). In addition to exercise, the typical comprehensive PR programme includes patient assessment, education, psychosocial support and nutritional counselling (ATS 1999; GOLD 2014; Spruit 2013). Pulmonary rehabilitation is typically delivered to groups of patients (rather than to individuals), but no evidence suggests the optimal size of the exercise group. However, the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR 2011) recommends a staff-to-participant ratio of 1:4, and the British Thoracic Society (British Thoracic Society 2001) a ratio of 1:8. The setting for PR programmes varies; both community-based (Cambach 1997; Casey 2013; Wijkstra 1994a) and home-based programmes (Maltais 2008; Viera 2010) are available. However, traditionally, most PR programmes have been hospital based (Bourbeau 2010), with participants attending as in-patients or on an out-patient basis.

The optimal duration of programmes, number of sessions offered per week and type of staff required to deliver PR programmes are unclear. Beauchamp 2011 concludes, following a systematic review, that available evidence is insufficient to show the optimal duration of PR programmes for people with COPD. However, a programme duration of at least eight weeks is recommended to attain a substantial effect (Beauchamp 2011). Likewise the number of times per week that programmes are offered differs; typically hospital-based out-patient programmes are offered two or three days per week, and in-patient programmes are offered over five days (Spruit 2013). The optimal number of sessions required remains unclear. However, the 2006 ATS/ERS guidelines specify three sessions per week or a twice-weekly supervised and one unsupervised home session (Nici 2006). Finally, key requirements

for staff delivering the programme are that they are clinically competent, having the required skills and knowledge and maintain patient safety (Spruit 2013).

How the intervention might work

Pulmonary rehabilitation seeks to reduce COPD symptoms, reestablish and improve functional ability, enhance participation in everyday life, promote autonomy and improve HRQoL (Spruit 2013). It does this by focusing on the systemic aspects of the disease that are common among patients with COPD (AACVPR 2011). The exercise component of PR increases inspiratory volume and reduces dynamic hyperinflation, both of which reduce dyspnoea when the person is performing tasks (Casaburi 2009). Exercise also increases muscle function, delaying fatigue and resulting in increased exercise tolerance. Meanwhile, the educational component of PR focuses on collaborative self-management and behaviour change (Spruit 2013). It encompasses providing information and knowledge regarding COPD; building skills such as goal setting, problem solving and decision making; and developing action plans that allow individuals to better recognise and manage the disease (Spruit 2013). The behaviour change element focuses on modifying nutritional intake and smoking patterns; adhering to medication and regular exercise; and utilising effective breathing techniques and energy-saving strategies (Spruit 2013).

Why it is important to do this review

Review authors undertook the original version of this Cochrane review in 2001 in response to worldwide endorsement of PR as integral to the management of COPD and lack of clear evidence as to the impact of these programmes on HRQoL and exercise tolerance (Lacasse 2001). The review included 23 randomised controlled trials (RCTs), and review authors concluded that PR (exercise training for a minimum of four weeks with or without education and/or psychological support) resulted in statistically significant improvement in HRQoL and modest improvement in exercise capacity (Lacasse 2001). This review was updated in 2006, included 31 RCTs and again reported statistically significant improvement in HRQoL. However, results for both functional and maximal exercise capacity were below the threshold of clinical significance. Lacasse 2006 concluded that further RCTs comparing PR versus usual care for patients with COPD were not needed. Despite this, a large number of RCTs published since 2006 have endorsed the need for this current update. Furthermore, recent RCTs tend to use disease-specific quality of life indices as primary outcome measures,, combined with more refined maximal and functional exercise capacity measurement tools (Curtis 2003; de Torres 2002; Gross 2004; Jones 2003). Consequently in the current review, we will take a more focused approach to assessment of primary and secondary outcomes. In recent years, wide variation has been noted in the follow-up assessment times utilised within studies, and this may have an impact on study outcomes. Therefore in the current review, we will include only assessments completed up to and within three months of completion of the intervention. Also, risk of bias requirements for Cochrane reviews have been altered since the last update; review authors of this current update will ensure that these new requirements are met. Finally, as a separate systematic review examining the effects of PR following exacerbations of COPD has been undertaken (Puhan 2011(a)), we will exclude from this review studies that commenced within four weeks of an acute exacerbation of COPD.

OBJECTIVES

To compare the effects of pulmonary rehabilitation versus usual care on health-related quality of life and functional and maximal exercise capacity in persons with COPD.

METHODS

Criteria for considering studies for this review

Types of studies

All RCTs in which participants are randomly assigned at the individual or cluster level and in which researchers compare the effects of PR versus those of usual care.

Types of participants

We included RCTs in which more than 90% of participants had COPD defined as:

- a clinical diagnosis of COPD; and
- best recorded forced expiratory volume after one second (FEV_1)/forced vital capacity (FVC) (FEV_1/FVC) ratio of individual participants < 0.7.

We included RCTs in which:

- any or all participants were on continuous oxygen.

We excluded RCTs that focused on participants:

- who were mechanically ventilated; or
- who had an acute exacerbation within four weeks before commencement of the intervention.

Types of interventions

Pulmonary rehabilitation

Any in-patient, out-patient, community-based or home-based rehabilitation programme of at least four weeks' duration that included exercise therapy with or without any form of education and/or psychological support delivered to patients with exercise limitation attributable to COPD.

We included any exercise therapy that included physical activity considered to be aerobically demanding.

We excluded:

- interventions in which the physical activity component was considered to be not aerobically demanding (e.g. respiratory muscle training, breathing exercises, Tai Chi, yoga) (the degree of aerobic demand was assessed for each individual intervention by examining the detailed description of the intervention in identified studies); and
- programmes of less than 4 weeks' duration.

Usual care

For the purpose of this review, usual care was defined as conventional care. We excluded trials in which the control group was given education or any form of additional intervention. Participants in the following situations were considered to be in receipt of usual care.

- Only verbal advice was given. If the advice was accompanied by additional education provided in any way, for example, by video or by diary, then the study was excluded.
- Medication was altered or optimised to what was considered best practice at the start of the trial for **all** participants.

Types of outcome measures

We considered disease-specific HRQoL and/or maximal or functional exercise capacity (up to and including three months after the end of the intervention). We defined 'maximal exercise capacity' as the peak capacity measured by an incremental cycle ergometry test. 'Functional exercise capacity' was defined according to the results of timed walk tests (Holland 2014).

Primary outcomes

Disease-specific health-related quality of life (HRQoL)

- Chronic Respiratory Disease Questionnaire (CRQ).
- St. George's Respiratory Questionnaire (SGRQ).

Secondary outcomes

Exercise testing

The classification of exercise testing is divided into functional and maximal exercise groups, which include the following (Holland 2014).

- Functional exercise capacity assessments.
  - Six-minute walk test/distance (6MWT/6MWD).
  - Incremental shuttle walk test (ISWT).
  - Endurance shuttle walk test (ESWT).
- Maximal exercise tests.
  - Incremental cycle ergometry.

Search methods for identification of studies

Electronic searches

We have detailed in Appendix 1 the search methods used in the previous version of this review. The previously published version included searches up to July 2004. The search period for this update is July 2004 to March 2014.

For the current update, we identified trials from the Cochrane Airways Group Specialised Register (CAGR), which is maintained by the Trials Search Co-ordinator for the Group. The Register contains trial reports identified through systematic searches of bibliographic databases including the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, EMBASE, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), the Allied and Complementary Medicine Database (AMED) and PsycINFO, and by handsearching of respiratory journals and meeting abstracts (please see Appendix 2 for further details). We searched all records in the CAGR using the search strategy described in Appendix 3.

We also conducted a search of ClinicalTrials.gov (www.ClinicalTrials.gov) and the World Health Organization (WHO) trials portal (www.who.int/ictrp/en/). We searched all databases from their inception to the present, with no restriction on the language of publication. We completed the latest searches in March 2014.

Searching other resources

We reviewed the reference lists of relevant articles and retrieved any potential additional citations. We contacted the authors of studies included in the meta-analysis and experts in the field of pulmonary rehabilitation to uncover unpublished material. We also included the papers suggested by the study authors contacted.

Data collection and analysis

The methods used in this review were designed in accordance with recommendations provided in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011).

Selection of studies

Two review authors (BMC, DC) independently tested the inclusion criteria and sought clarification on all areas of concern with the wider review team, which included the original author of the review (YL). When the review authors were confident of the clarity of the criteria and their skills, they assessed studies with respect to the identified criteria. The two review authors then independently assessed all citation titles and abstracts. Review authors electronically collated initial decisions with the use of Distiller SR and later with Early Reviewing Software (EROS); they coded each citation as:

- included to proceed;
- more information needed before inclusion decision;
- important article but not to be included in the review; or
- excluded (Appendix 4; Appendix 5).

Review authors held a meeting after every 100 reviewed citations during which they resolved disagreements by consensus. They used quadratic weighted Kappa statistics to measure agreement between coders (Kramer 1981). When consensus could not be reached, a third review author (DD) adjudicated. Review authors then retrieved full-text papers of all potentially eligible studies. Review authors maintained records on all studies that did not meet the inclusion criteria and provided the rationale for their exclusion.

Data extraction and management

The lead review author (BMC) extracted data from all original papers identified for inclusion in the meta-analysis using a developed data extraction form. The other members of the review group (DC, KM, DD, EM) independently extracted data from an equal share of the same studies. Extracted information included the following.

- Background characteristics of the research reports.
- Characteristics of participants in the study.
- The number and distribution of participants who dropped-out or withdrew from the study.
- A full description of the pulmonary rehabilitation programmes (setting, components and duration).
- Health-related quality of life measurement instruments and associated results.
- Exercise capacity measure outcomes and corresponding results.

The lead review author and co-review authors resolved discrepancies during the data extraction process through discussion; they consulted a third review author when unresolved issues remained. Review authors requested missing data from the

authors of the primary studies. They asked these authors to provide additional information by filling in tables similar to the ones used by the review authors during the data extraction process. Two review authors (BMC, EM) entered all data into the Review Manager software (RevMan 2011) and checked them for accuracy.

If a study reported multiple group comparisons (e.g. exercise therapy with inspiratory muscle training compared with exercise therapy alone or with conventional community care), treatment groups considered relevant to PR were combined as if one intervention group,.and this group was compared with the group receiving conventional community care. Studies in which multiple group comparisons included interventions that were not considered relevant to PR such as acupuncture were not combined.

Assessment of risk of bias in included studies

The lead review author (BMC) assessed the risk of bias for all included studies. A second review author (DC, EM or KM) independently assessed the risk of bias for each study. The review authors followed the criteria for assessing risk of bias provided by The Cochrane Collaboration in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011) and contained in RevMan (RevMan 2011). We assessed risk of bias according to the following domains (Appendix 6).

- Random sequence generation.
- Allocation concealment.
- Blinding of participants and personnel.
- Blinding of outcome assessment.
- Incomplete outcome data.
- Selective outcome reporting.
- Other bias.

We considered several important potential sources of bias that have proved to be major determinants of the magnitude of the effect size in clinical trials: unconcealed randomisation, unblinded study personnel, incomplete outcome data and attrition of more than 20% of those randomly assigned. The first of these has been associated with an overestimation of treatment effect by up to 40% (Schulz 1995), and the second may result in differential encouragement during performance testing, with the potential for distortion of the results (up to 30.5 metres in a six-minute walk test) (Guyatt 1984). Schulz 1995 argued that loss to follow-up of 20% or greater should be a matter of concern as it relates to the possibility of bias.

Review authors resolved disagreements by consensus. If details pertaining to randomisation, masking, drop-out and withdrawal were not specified or were unclear in the original trial publication, we contacted the study authors to clarify the issue.

Measures of treatment effect

Continuous data

Different measures of HRQoL and exercise capacity have been reported in the primary studies. Both primary outcomes (HRQoL) and secondary outcomes (exercise capacity) are continuous outcomes. For these continuous variables, we recorded mean change from baseline or mean postintervention values and standard deviation (SD) for each group for outcomes measured using the same metrics. When 95% confidence intervals (CIs) and standard errors (SEs) were reported, we calculated SDs as guided by the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). When SDs were missing from studies and it was not possible to obtain the results from study authors, we used a mean value for the SD of the other studies that reported that outcome. All outcomes were reported independently, so standardised mean differences (SMDs) for outcomes were not required. Mean differences (MDs) with 95% CIs were calculated for each study by using a random-effects model.

Dichotomous data

We did not plan to analyse dichotomous outcomes.

Unit of analysis issues

Cluster-randomised trials

We included cluster-randomised trials in the analysis for the current review alongside individually randomised trials. We made an adjustment to the sample size in these studies for each intervention based on the method described in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). This method utilised the intracluster correlation co-efficient (ICC) as calculated from trial results.

Multi-armed trials

We included multi-armed trials in this review. To overcome potential issues due to multiple, correlated comparisons, we analysed multi-armed trials using methods described in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). When feasible, we combined multiple comparison groups to create one relevant intervention group and one relevant comparison group.

Dealing with missing data

For included studies, we noted the level of attrition; any study with greater than 20% attrition was considered at high risk of attrition bias. When standard deviations (SDs) of the change were missing from studies, and it was not possible to obtain the result from study authors, we used the mean value for the SD of other included studies that reported that outcome. We excluded from the analysis studies in which only medians and percentiles were available and study authors reported no other means of calculating mean change scores.

Assessment of heterogeneity

We assessed heterogeneity visually through inspection of forest plots, and statistical heterogeneity in each meta-analysis using Tau^2, I^2 and Chi^2 statistics. We regarded heterogeneity as substantial when Tau^2 was greater than zero and I^2 was greater than 30% or a low P value (< 0.10) was reported for the Chi^2 test for heterogeneity.

Assessment of reporting biases

When 10 or more studies were included in the meta-analysis, we investigated reporting biases (such as publication bias) by using funnel plots. When asymmetry was suggested on visual assessment, we undertook exploratory analyses to investigate asymmetry using the test proposed by Egger 1997 (see Table 1).

Figure 1. Funnel plot of comparison: 1 Rehabilitation versus usual care, outcome: 1.4 QoL - Change in CRQ (Dyspnoea) (see Table 1 for Egger and Begg-Mazumdar: Kendall's test results).

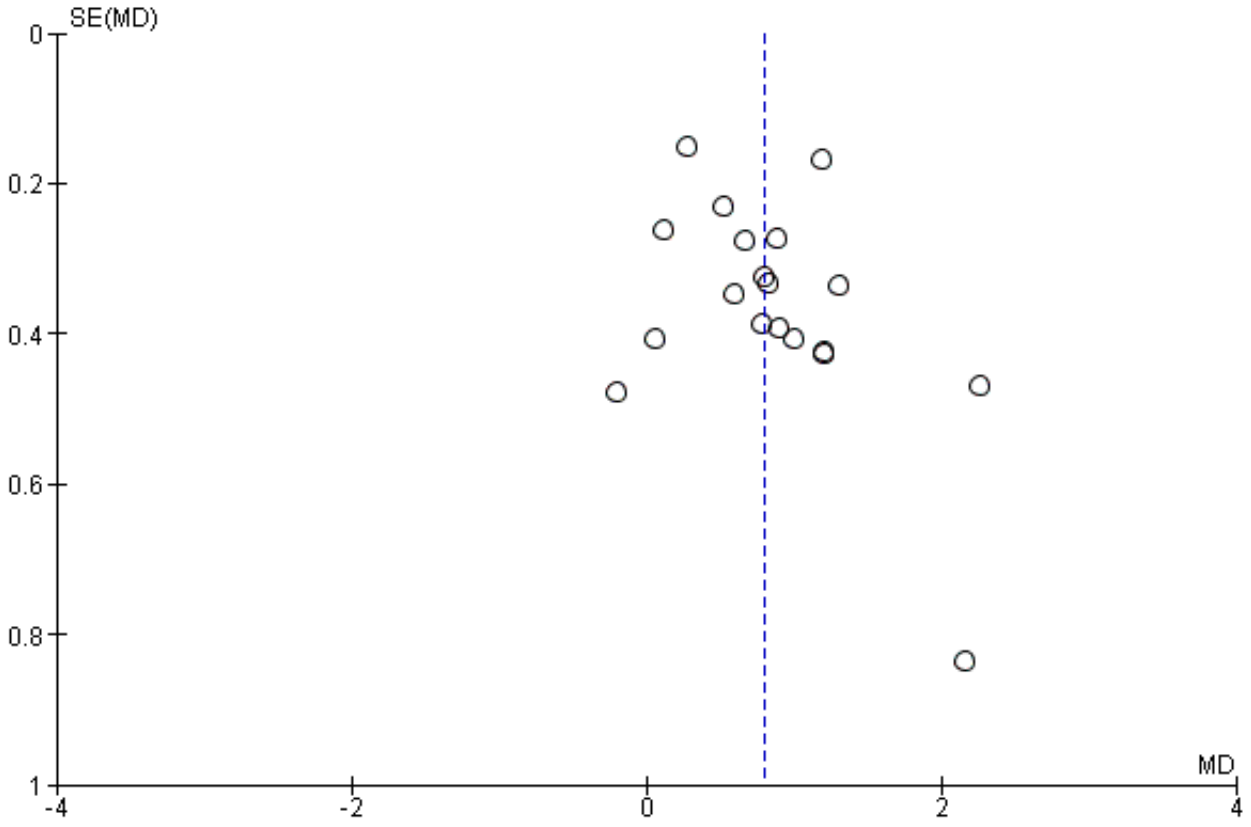
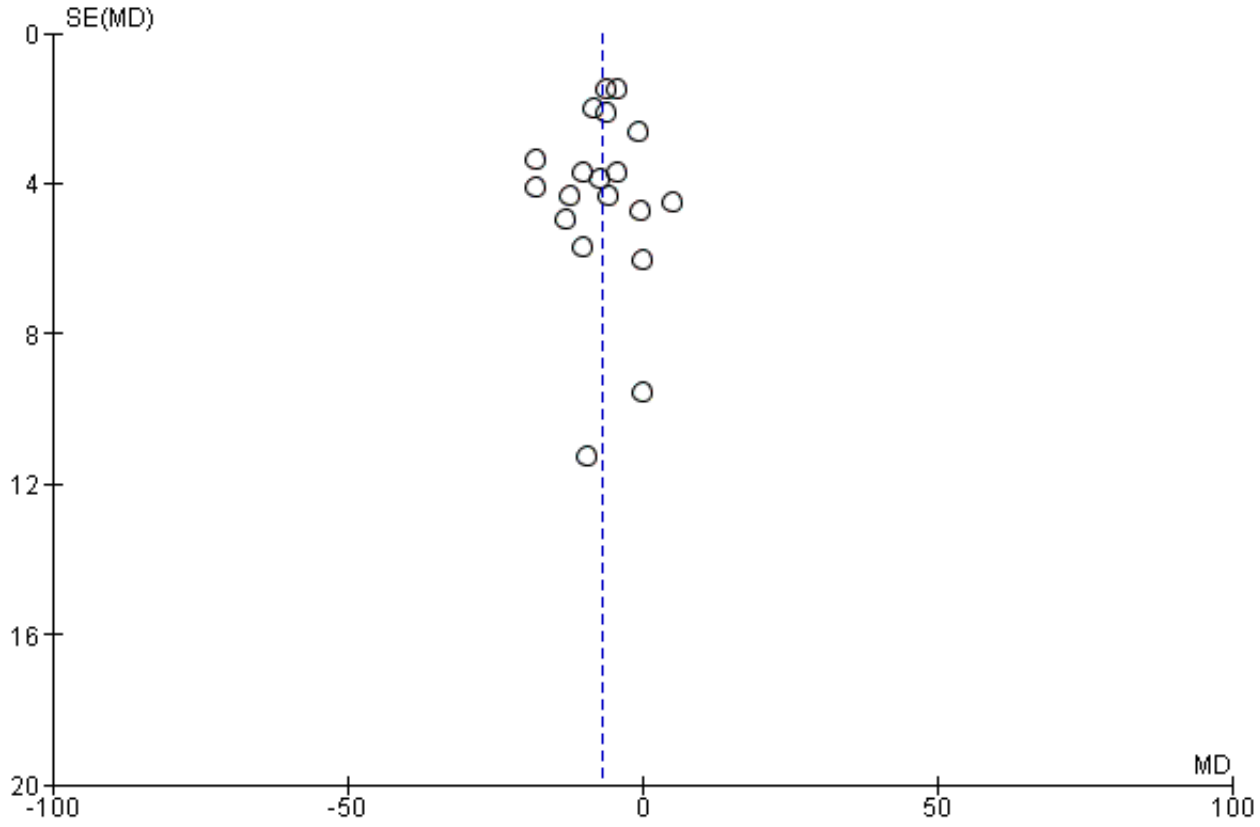


Figure 2. Funnel plot of comparison: 1 Rehabilitation versus usual care, outcome: 1.5 QoL - Change in SGRQ (Total) (see Table 1 for Egger and Begg-Mazumdar: Kendall's test results).



Data synthesis

Review authors undertook statistical analysis by using Review Manager software (RevMan 2011). Throughout the analysis, we used mean differences (MDs) as determined (to take into account pre-experiment group differences) from the differences between preintervention and postintervention changes in treatment and control groups. We combined MDs according to random-effects analyses (Shadish 1994) and presented the results as average treatment effects with 95% CIs and estimates of Tau^2 and I^2. In the case of cross-over trials, we considered only the first study period and excluded from the analysis data obtained during the second study period. We explored heterogeneity through a priori specified subgroup analyses. When possible, for each outcome, we discussed the summary effect estimate in the context of its minimal clinically important difference (MCID). The MCID is defined as the smallest difference in score corresponding to the smallest difference perceived by the average patient that would mandate, in the absence of troublesome side effects and excessive costs, a change in management of a patient's condition (Jaeschke 1989).

Subgroup analysis and investigation of heterogeneity

To explain anticipated heterogeneity among study results, we defined a set of three a priori hypotheses on which sensitivity analyses were to be based. We identified potential sources of heterogeneity in relation to the outcomes of exercise capacity and HRQoL. We then classified these hypotheses into subcategories as follows.

Interventions

The contribution of each of the components of PR programmes to patient improvement in exercise capacity and HRQoL is not known. We hypothesised that the more comprehensive the rehabilitation programme, the larger would be the effect size in improving exercise capacity and HRQoL. We also hypothesised that a difference in intervention effect may be noted between hospital only-based and community/home-based interventions. Therefore, we performed a subgroup analysis of:

- pulmonary rehabilitation and exercise only interventions versus PR plus a more comprehensive intervention within which education was included; and
- hospital only-based versus community/home-based programmes.

Methodological quality

We hypothesised that the results of trials would be influenced by their methodological quality. For the purpose of this subgroup analysis, we defined high-quality trials as those at low risk of bias for:

- allocation concealment; or
- incomplete outcome data (i.e. loss to follow-up ≥ 20%).

We assessed for subgroup differences by using interaction tests available within RevMan (RevMan 2011). We reported the results of

subgroup analyses by quoting the statistic and the P value, and the interaction test by providing the I^2 value.

Sensitivity analysis

We performed sensitivity analyses on the basis of trial quality by repeating our analysis among only those trials judged to be of 'high quality.' For the purposes of this review, 'high-quality' trials are defined as trials with low risk of bias due to allocation concealment or low risk of bias due to incomplete outcome data. We limited sensitivity analyses to primary outcomes (see Types of outcome measures).

RESULTS

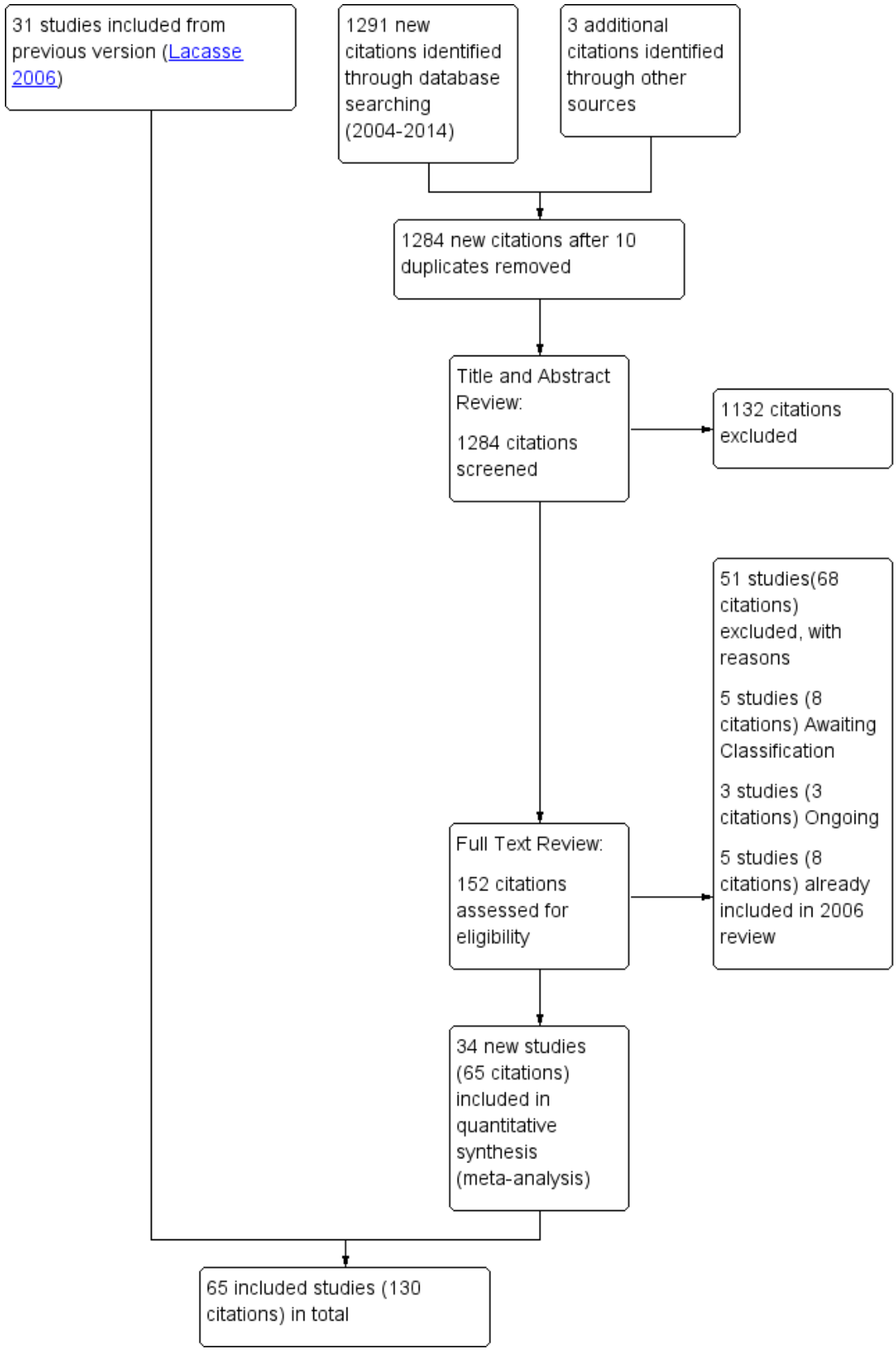
Description of studies

See Characteristics of included studies and Characteristics of excluded studies as well as baseline characteristics (Table 2) and study design (Table 3).

Results of the search

Our search yielded 1284 citations with potential for inclusion (see Figure 3). We excluded 1132 citations during the initial screening of titles and abstracts and assessed 98 studies (152 citations) on the basis of a full-text review. Of these, 51 studies (68 citations) failed to meet the inclusion criteria. A further five studies (eight citations) provided insufficient detail to allow a decision and are still awaiting classification (see Characteristics of studies awaiting classification). Of these, we conducted a teleconference with the author of two studies (Meshcheryakova 2010; Meshcheryakova 2012) and are awaiting additional unpublished information. We were not able to establish contact with the authors of the other three studies (Aksu 2006; D'Amico 2010; Ren 2011). Three studies were ongoing at the time of this review, and results were not yet published; the study authors wished to withhold results until after publication (Chang 2008; Gurgun 2011; Sathyapala 2008) (see Characteristics of ongoing studies). In addition, eight citations were related to five studies that were already included in the previous version of this review. Thus, 34 studies (65 citations) were included for the first time in this review, in addition to the 31 studies (65 citations) already included in the previous version of the review. We have provided details of the literature search for the previous version of the review in Appendix 1.

Figure 3. Study flow diagram.



Included studies

We included the 31 RCTs from the 2006 version of the Cochrane review (Lacasse 2006). A total of 65 studies (represented by 130 citations) contributed to this meta-analysis, including 34 new studies (Barakat 2008; Baumann 2012; Borghi-Silva 2009; Casey 2013; Cebollero 2012; Chan 2011; Cochrane 2006; De Souto Araujo 2012; Deering 2011; Elci 2008; Faager 2004; Faulkner 2010; Fernandez 2009; Gohl 2006; Gomez 2006; Gottlieb 2011; Gurgun 2013; Hoff 2007; Karapolat 2007; Lindsay 2005; Liu 2012; McNamara 2013; Mehri 2007; Mendes De Oliveira 2010; Nalbant 2011; O'Shea 2007; Ozdemir 2010; Paz-Diaz 2007; Petty 2006; Sridhar 2008; Theander 2009; Van Wetering 2010; Vijayan 2010; Wen 2008), in addition to the 31 studies included in the original review (Behnke 2000a; Bendstrup 1997; Booker 1984; Boxall 2005; Busch 1988; Cambach 1997; Casaburi 2004; Chlumsky 2001; Clark 1996; Cockcroft 1981; Emery 1998; Engström 1999; Finnerty 2001; Goldstein 1994; Gosselink 2000; Griffiths 2000; Güell 1995; Güell 1998; Hernandez 2000; Jones 1985; Lake 1990; McGavin 1977; Reardon 1994; Ringbaek 2000; Simpson 1992; Singh 2003; Strijbos 1996; Vallet 1994; Weiner 1992; Wijkstra 1994; Xie 2003). We provided descriptions of these individual studies in the Characteristics of included studies table.

These studies involved 3822 participants, 2090 of whom were randomly allocated to some form of exercise rehabilitation for a minimum duration of four weeks, and 1732 individuals who were randomly assigned to usual care. For a detailed account of the criteria required for inclusion, see Criteria for considering studies for this review. The sample size in the included studies ranged from 12 participants (Hoff 2007) to 350 participants (Casey 2013) with a median of 45 participants (interquartile range (IQR) 29.5 to 67). We noted a large gender imbalance across all studies, with 69% of participants being male and with 10 studies including no female participants.

Only six studies reported patient-based programmes, three of which were combined with a home-based follow-up component. Thirty-seven studies were hospital out-patient based; eight of these included a home-based element. In all, 21 programmes were community based, 11 of which were entirely home based, and one programme combined community- and home-based components. The venue for the programme run by Vijayan 2010 was unclear from the reports. The duration of the programmes ranged from four weeks (three studies) to one year (three studies). Eight- and 12-week programmes (18 studies of each) were most common. Timelines for assessment of participants followed a pattern identical to that of programme duration.

All but two trials that met the inclusion criteria used a standard parallel-group design. Casey 2013 utilised cluster samples from general practices, whereas Cambach 1997 conducted a cross-over trial. Most studies (48 trials) randomly assigned participants to two groups (i.e. rehabilitation and usual care), and three trials randomly assigned participants to three intervention groups, in addition to the usual care group (Casaburi 2004; Cochrane 2006; Lake 1990). The remaining 14 trials utilised two intervention groups and a usual care group (Cebollero 2012; De Souto Araujo 2012; Deering 2011; Emery 1998; Gomez 2006; Gurgun 2013; Jones 1985; Liu 2012; McNamara 2013; Mendes De Oliveira 2010; Petty 2006; Strijbos 1996; Weiner 1992; Wen 2008)

Excluded studies

We excluded 51 studies from the current update during the full-text screening process.The Characteristics of excluded studies table provides full details of the excluded studies.

Risk of bias in included studies

As a result of the nature of the intervention, it was expected that blinding of participants and of professionals who delivered the interventions was not possible. Consequently, risk of performance bias in all studies was high. Risk of bias for other bias domains varied across included studies, and insufficient detail was provided to inform judgement in several included studies (see Figure 4, Risk of bias summary table, and Figure 5, Risk of bias graph, for an overview).

Figure 4. Risk of bias summary: review authors' judgements about each risk of bias item for each included study.

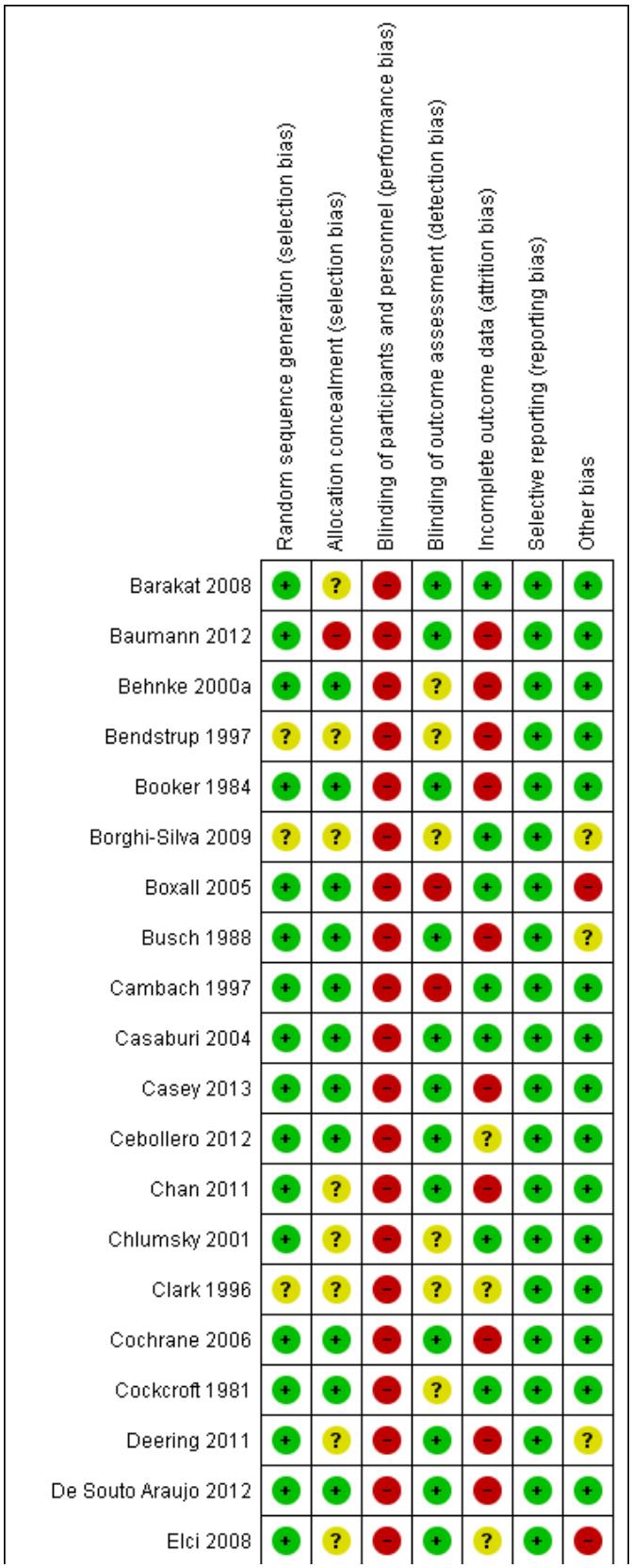


Figure 4. (Continued)

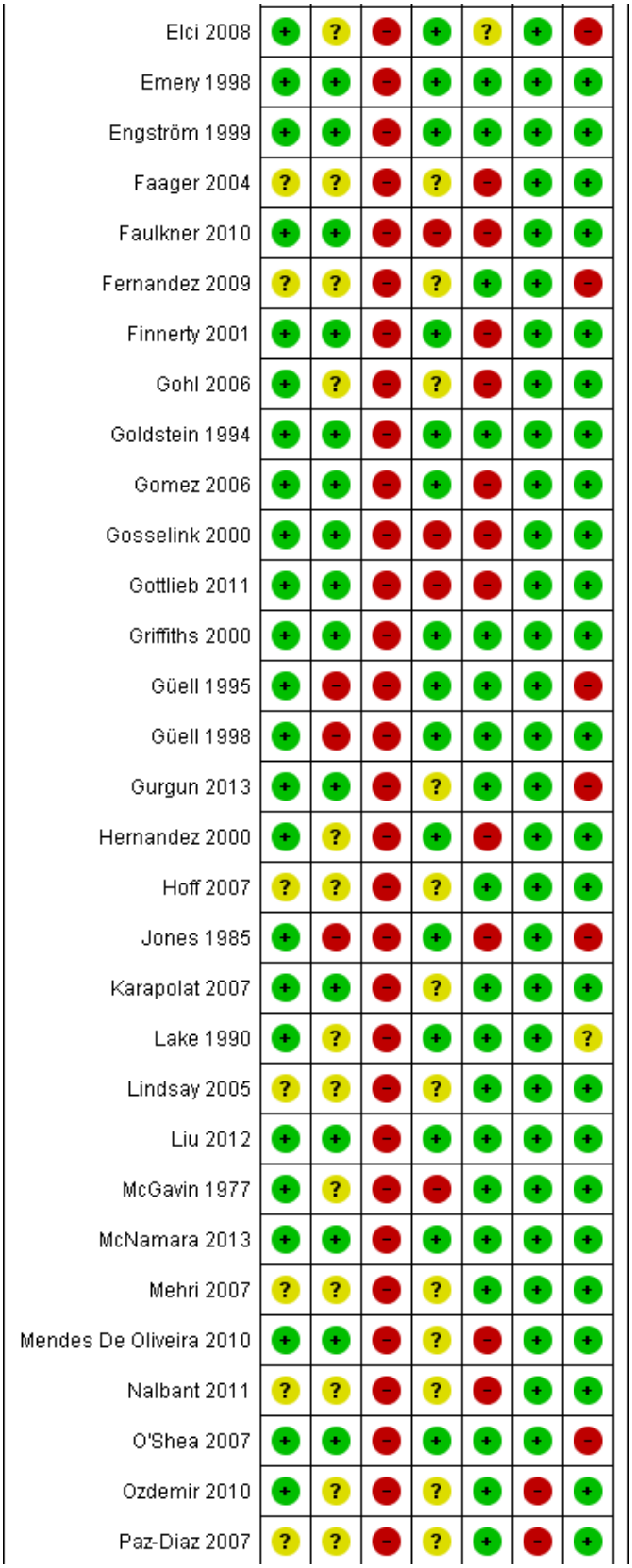


Figure 4. (Continued)

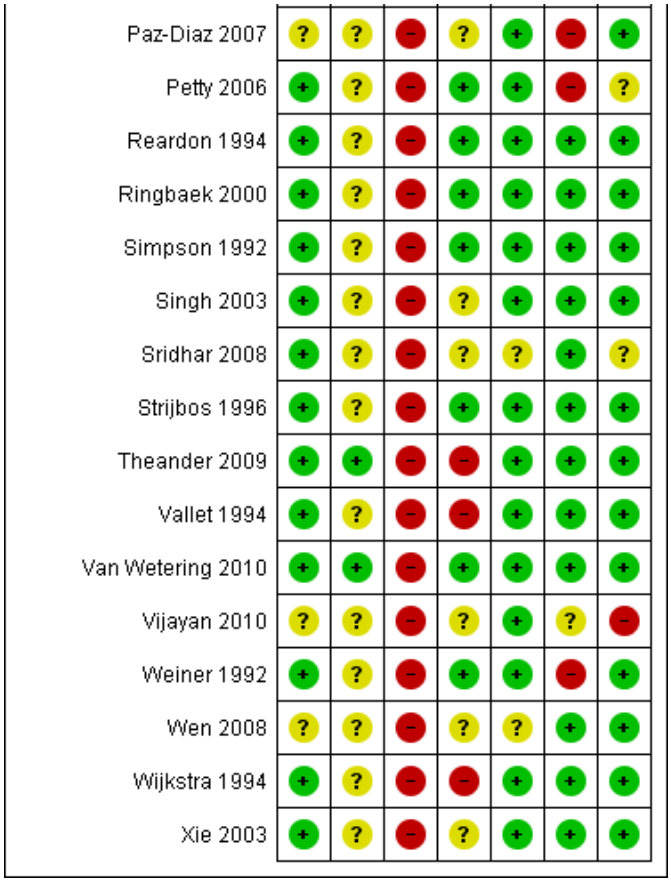
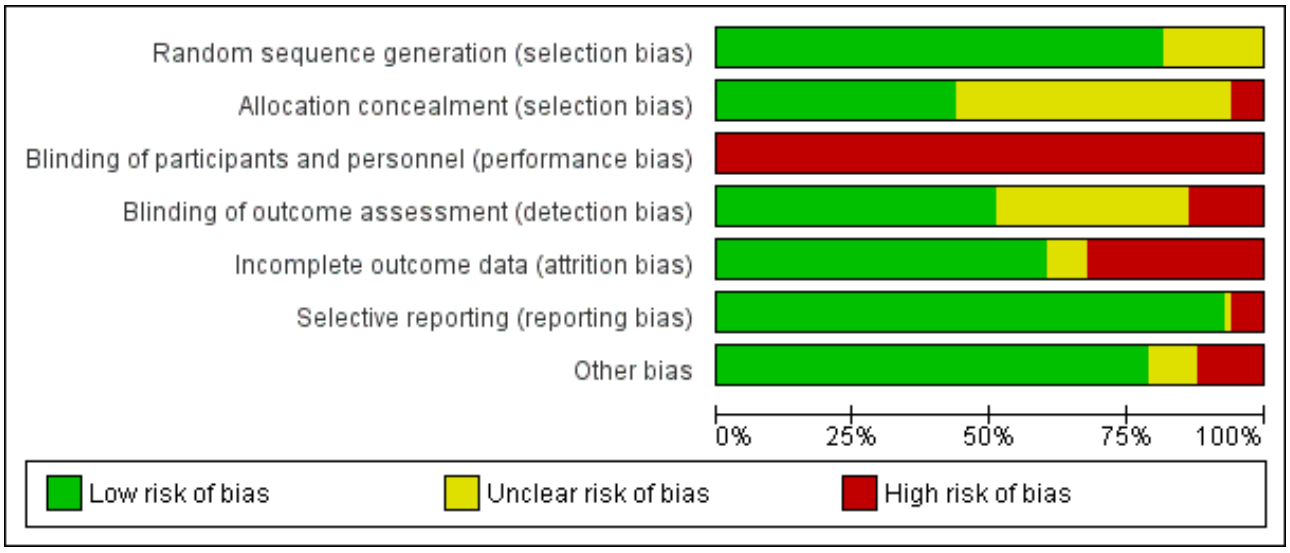


Figure 5. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.



Allocation

We judged 53 included studies as having low risk of bias in random sequence generation. Information was insufficient to permit a decision in relation to 12 trials (Bendstrup 1997; Borghi-Silva 2009; Clark 1996; Faager 2004; Fernandez 2009; Hoff 2007; Lindsay 2005; Mehri 2007; Nalbant 2011; Paz-Diaz 2007; Vijayan 2010; Wen 2008). With regard to allocation concealment, we judged 28 studies as having low risk of bias (Behnke 2000a; Booker 1984; Boxall 2005;

Busch 1988; Cambach 1997; Casaburi 2004; Casey 2013; Cebollero 2012; Cochrane 2006; Cockcroft 1981; De Souto Araujo 2012; Emery 1998; Engström 1999; Faulkner 2010; Finnerty 2001; Goldstein 1994; Gomez 2006; Gosselink 2000; Gottlieb 2011; Griffiths 2000; Gurgun 2013; Karapolat 2007; Liu 2012; McNamara 2013; Mendes De Oliveira 2010; O'Shea 2007; Theander 2009; Van Wetering 2010) and four studies as having high risk of bias (Baumann 2012; Güell 1995; Güell 1998; Jones 1985); the remaining 33 studies provided insufficient information to inform judgements.

Blinding

Performance bias

As a result of the nature of the intervention, it was not possible to blind participants or professionals who delivered the interventions. Consequently, we judged all studies as having high risk of performance bias.

Detection bias

Across studies, the level of reporting of whether outcome assessment was blinded was relatively poor. We judged 32 studies as having low risk of detection bias (Barakat 2008; Booker 1984; Busch 1988; Casaburi 2004; Casey 2013; Cebollero 2012; Chan 2011; Cochrane 2006; De Souto Araujo 2012; Deering 2011; Elci 2008; Emery 1998; Engström 1999; Finnerty 2001; Goldstein 1994; Gomez 2006; Griffiths 2000; Güell 1995; Güell 1998; Hernandez 2000; Jones 1985; Lake 1990; Liu 2012; McNamara 2013; O'Shea 2007; Petty 2006; Reardon 1994; Ringbaek 2000; Simpson 1992; Strijbos 1996; Van Wetering 2010; Weiner 1992). In two of these studies (Engström 1999; Simpson 1992), the primary outcome assessment (quality of life) was blinded but the secondary outcome assessment (exercise capacity) was not. In Lake 1990, the cycle ergometer test was blinded, but the six-minute walk test was not. In Busch 1988, the cycle ergometer test was not blinded and the 12-minute walk test was blinded. Among studies that reported blinding of outcome assessment, nine studies were judged as having high risk of detection bias (Boxall 2005; Cambach 1997; Faulkner 2010; Gosselink 2000; Gottlieb 2011; McGavin 1977; Theander 2009; Vallet 1994; Wijkstra 1994), and the remaining 23 studies provided insufficient information to inform judgements.

Incomplete outcome data

We judged 39 studies as having low risk of attrition bias (Barakat 2008; Borghi-Silva 2009; Boxall 2005; Cambach 1997; Casaburi 2004; Chlumsky 2001; Cockcroft 1981; Emery 1998; Engström 1999; Fernandez 2009; Goldstein 1994; Griffiths 2000; Güell 1995; Güell 1998; Gurgun 2013; Hoff 2007; Karapolat 2007; Lake 1990; Lindsay 2005; Liu 2012; McGavin 1977; McNamara 2013; Mehri 2007; O'Shea 2007; Ozdemir 2010; Paz-Diaz 2007; Petty 2006; Reardon 1994; Ringbaek 2000; Simpson 1992; Singh 2003; Strijbos 1996; Theander 2009; Vallet 1994; Van Wetering 2010; Vijayan 2010; Weiner 1992; Wijkstra 1994; Xie 2003) and 22 as having high risk (Baumann 2012 24% of people dropped out; Behnke 2000a 35%; Bendstrup 1997 24%; Booker 1984 27%; Busch 1988 30%; Casey 2013 24%; Chan 2011 23%, Cochrane 2006 43%; De Souto Araujo 2012 24%; Deering 2011 42%; Faager 2004 30%; Faulkner 2010 30%; Finnerty 2001 43%; Gohl 2006 44%; Gomez 2006 48%; Gosselink 2000 62%; Gottlieb 2011 32%; Hernandez 2000 38%; Jones 1985 26%; Mendes De Oliveira 2010 27%; Nalbant 2011 28%; Wen 2008 24%). Information was insufficient to inform judgements in five studies (Cambach 1997; Cebollero 2012; Clark 1996; Elci 2008; Vijayan 2010).

Selective reporting

We found no trial registration protocol for most studies to check whether all prespecified outcomes were reported in the articles. However, outcomes listed in the methods section of the included studies were reported in the results section, with the exception of four studies that were judged to have high risk of reporting bias (i.e. Ozdemir 2010, whose results for the CRQ are incomplete; Paz-Diaz 2007, who did not provide results for the rehabilitation group for CRQ; Petty 2006, in which results of the six-minute walk test and Short Form (SF)-36 are not presented; and Weiner 1992, in which results of the SGRQ are not available). In relation to publication bias, we visually reviewed the funnel plots (Figure 3; Figure 1; Figure 2) and followed this by performing the Egger test (Egger 1997) (Table 1). Egger test results showed no significant publication bias across the studies included in the current meta-analysis.

Other potential sources of bias

We found no other source of bias, with the exception of a tendency toward increased proportions of male participants, as was highlighted earlier.

Effects of interventions

See: **Summary of findings for the main comparison** Rehabilitation versus usual care for chronic obstructive pulmonary disease

Pulmonary rehabilitation versus usual care

For this comparison, we included all participants who were randomly assigned in the included studies and received PR (defined as exercise training for at least four weeks with or without educational and/or psychological support) and those allocated to usual care (see Characteristics of included studies for details). We also undertook subgroup analysis as discussed in the Subgroup analysis and investigation of heterogeneity section. All outcomes results utilised in the analyses were based on baseline assessment measurements and the earliest follow-up assessment up to three months after completion of the intervention.

Primary outcomes

Health-related quality of life

Among the 65 trials that met the inclusion criteria of the meta-analysis, 44 made an attempt to measure HRQoL using eight different strategies. Only three of these strategies - the Transitional Dyspnoea Index (TDI; Mahler 1984), the Chronic Respiratory Disease Questionnaire (CRQ; Guyatt 1987a) and the St. Georges Respiratory Questionnaire (SGRQ; Jones 1992) - have been demonstrated to be valid and responsive. Of these, the CRG and the SGRQ have become the recognised standard of assessment of HRQoL amongst patients with COPD and are reported here. We analysed the CRQ and the SGRQ separately. Not all subscales were fully completed by all participants, so the numbers of participants per outcome and per subscale varied.

Chronic Respiratory Disease Questionnaire (CRQ)

Scores for the CRQ are reported on a 7-point scale. Although 23 studies utilised the CRQ to assess HRQoL, only 19 studies (1291 participants) provided results suitable for analysis.

Participants allocated to rehabilitation programmes had, on average, significantly greater changes in HRQoL CRQ scores across all subscales when compared with participants allocated to control groups (Fatigue: MD 0.68, 95% CI 0.45 to 0.92; 19 trials; 1291 participants; $Tau^2 = 0.15$; $I^2 = 64\%$; Analysis 1.1; Emotional function: MD 0.56, 95% CI 0.34 to 0.78; 19 trials; 1291 participants; $Tau^2 = 0.12$; $I^2 = 58\%$; Analysis 1.2; Mastery: MD 0.71, 95% CI 0.47 to 0.95; 19 trials; 1212 participants; $Tau^2 = 0.16$; $I^2 = 63\%$; Analysis 1.3; Dyspnoea: MD 0.79, 95% CI 0.56 to 1.03; 19 trials; 1283 participants; $Tau^2 = 0.15$; $I^2 = 63\%$; Analysis 1.4).

For each of the CRQ domains (dyspnoea, fatigue, emotional function and mastery), the common effect size exceeded the 'minimal clinically important difference' (MCID) (0.5 points on the 7-point scale) (Jaeschke 1989). The lower limit of the confidence interval around the common treatment effect of the dyspnoea domains (Analysis 1.4) exceeded the MCID, indicating not only statistical significance but also clinical significance in the effect of PR. The lower limits of the remaining domains were slightly below the MCID (Analysis 1.1; Analysis 1.2; Analysis 1.3).

Heterogeneity identified across all domains of the CRQ was substantial, as Tau^2 was greater than zero, and in all cases, I^2 was greater than 30% and the P value for the Chi^2 test was less than 0.10. We undertook subgroup and sensitivity analyses to try to explore heterogeneity; although findings are presented later, they did not explain the high level of heterogeneity.

St. George's Respiratory Questionnaire (SGRQ)

Scores for the SGRQ are reported on a 100-point scale. Twenty trials utilised the SGRQ to assess the HRQoL of participants. Results were available in a usable format from 19 trials (a maximum of 1153 participants) for inclusion in the meta-analysis. Barakat 2008 was not included in the analysis, as clarification regarding the SD of the change is needed from the study authors.

Similar to the CRQ, participants allocated to PR programmes had, on average, significantly greater changes in SGRQ scores across all subscales when compared with participants allocated to control groups (SGRQ total: MD -6.89, 95% CI -9.26 to -4.52; 19 trials; 1146 participants; $Tau^2 = 13.17$; $I^2 = 59\%$; Analysis 1.5; SGRQ symptoms: MD -5.09, 95% CI -7.69 to -2.49; 19 trials; 1153 participants; $Tau^2 = 7.79$; $I^2 = 26\%$; Analysis 1.6; SGRQ impact: MD -7.23, 95% CI -9.91 to -4.55; 19 trials; 1149 participants; $Tau^2 = 17.94$; $I^2 = 58\%$; Analysis 1.7; SGRQ activity: MD -6.08, 95% CI -9.28 to -2.88; 19 trials; 1148 participants; $Tau^2 = 27.01$; $I^2 = 64\%$; Analysis 1.8).

For each of the SGRQ domains (as well as the total SGRQ score), the common effect size exceeded the MCID of four (Jones 1991; Quirk 1991) (Analysis 1.5; Analysis 1.6; Analysis 1.7; Analysis 1.8). All results of the analysis for all domains of the SGRQ were statistically significant. However, the extent of the 95% CI around the pooled treatment effect exceeds the MCID only for the SGRQ total and SGRQ impact domains of the SGRQ, demonstrating unequivocal clinical and statistical significance in these domains.

Heterogeneity in results obtained from the total and all subscales of the SGRQ was substantial, with the exception of the symptoms subscale (Analysis 1.6).

Secondary outcomes

Maximal exercise capacity

A total of 34 trials measured maximal exercise capacity. We limited the meta-analysis to the 16 trials that used the incremental cycle ergometer test.

Investigators in 16 studies (779 participants) used the incremental cycle ergometer test. On average, a statistically significant increase in mean Wmax (W) was reported among participants allocated to PR compared with those allocated to usual care (MD 6.77, 95% CI 1.89 to 11.65; $Tau^2 = 40.97$; $I^2 = 74\%$; Analysis 1.10). The common effect size exceeded the MCID (4 watts) proposed by Puhan 2011(b). The maximal exercise test showed substantial heterogeneity in the results obtained.

Functional exercise capacity

Of the included studies, 43 trials used the six-minute walk test as an outcome. Of these, 38 (1879 participants: 1012 actively treated, 867 controls) presented the results in a format that could be used for the meta-analysis (see Analysis 1.11). Investigators reported a statistically significant increase, on average, in the mean difference in metres walked associated with PR (MD 43.93 m, 95% CI 32.64 to 55.21; $Tau^2 = 713.49$; $I^2 = 74\%$; Analysis 1.11). Both the common effect and the lower limit of its confidence interval exceeded the MCID for the 6WMD of 30 metres, as recommended by Holland 2014, indicating the clinical significance of the effect of PR. .

Eight trials (694 participants) reported data on the incremental shuttle walk test (ISWT). These test results were analysed independently from those of the 6MWT. On average, a statistically significant increase in mean metres walked was noted among participants allocated to PR compared with those allocated to usual care (MD 39.77, 95% CI 22.38 to 57.15; $Tau^2 = 181.56$; $I^2 = 32\%$). This result is slightly below the MCID of 47.5 m (Singh 2008; Singh 2014) to make this a finding of clinical significance.

Similar to previous outcomes on maximal exercise, both the six-minute walk test and the analyses demonstrated substantial heterogeneity.

Several other outcome measures were used to measure functional capacity, but because of the limited numbers of trials providing data for these other outcomes (endurance shuttle walk test: two trials; 12-minute walk test: four trials); four-minute walk test: one trial)), these findings were not included in the meta-analysis.

Subgroup and sensitivity analyses

Rehabilitation versus usual care (subgroup analysis hospital- versus community-based pulmonary rehabilitation)

In total, 39 included studies were considered to have a hospital-based PR intervention delivered on an in-patient or out-patient basis. A total of 25 studies focused on programmes that were delivered in the community at community centres or in individuals' homes. One study had both a community-based and an out-patient-based intervention group, so it was excluded from the subgroup analysis (Mendes De Oliveira 2010).

In the subgroup analysis for the CRQ domain outcomes, the 'community' subgroup included nine studies (Cambach 1997; Casey 2013; Faulkner 2010; Gomez 2006; Hernandez 2000; Lindsay 2005; O'Shea 2007; Singh 2003; Wijkstra 1994) and the 'hospital

group' included 10 studies (Behnke 2000a; Cebollero 2012; Goldstein 1994; Gosselink 2000; Griffiths 2000; Güell 1995; Güell 1998; McNamara 2013; Simpson 1992; Sridhar 2008;). For SGRQ outcomes, the community subgroup included nine studies (Baumann 2012; Boxall 2005; Chan 2011; De Souto Araujo 2012; Elci 2008; Fernandez 2009; Gohl 2006; Gottlieb 2011; Van Wetering 2010) and the hospital subgroup included 10 studies (Chlumsky 2001; Deering 2011; Engström 1999; Finnerty 2001; Griffiths 2000; Gurgun 2013; Karapolat 2007; Paz-Diaz 2007; Ringbaek 2000; Theander 2009).

Evidence suggested a significant difference in treatment effect between subgroups for all domains of the CRQ, with higher mean values, on average, in the PR group in hospital than in the community-based group (Analysis 2.1; Analysis 2.2; Analysis 2.3; Analysis 2.4). No subgroup differences were reported for any of the SGRQ domains (Analysis 2.5; Analysis 2.6; Analysis 2.7; Analysis 2.8).

Rehabilitation versus usual care (subgroup analysis 'exercise only' vs 'exercise plus more comprehensive components')

A total of 31 trials were included in the 'exercise only' subgroup, and 34 trials in the 'exercise plus more comprehensive components' subgroup, of which 10 trials in the 'exercise only' subgroup (Cebollero 2012; Gosselink 2000; Güell 1995; Güell 1998; Hernandez 2000; McNamara 2013; O'Shea 2007; Simpson 1992; Singh 2003; Sridhar 2008), and nine in the more comprehensive subgroup (Behnke 2000a; Cambach 1997; Casey 2013; Faulkner 2010; Goldstein 1994; Gomez 2006; Griffiths 2000; Lindsay 2005; Wijkstra 1994) reported CRQ data.

For the SGRQ, five trials were included in the 'exercise only' subgroup (Chan 2011; Chlumsky 2001; De Souto Araujo 2012; Gohl 2006; Paz-Diaz 2007) and 14 trials in the more comprehensive subgroup (Baumann 2012; Boxall 2005; Deering 2011; Elci 2008; Engström 1999; Fernandez 2009; Finnerty 2001; Gottlieb 2011; Griffiths 2000; Gurgun 2013; Karapolat 2007; Ringbaek 2000; Theander 2009; Van Wetering 2010).

No evidence was found of a significant treatment effect between subgroups for all domains of the CRQ (Analysis 3.1; Analysis 3.2; Analysis 3.3; Analysis 3.4) and the SGRQ (Analysis 3.5; Analysis 3.6; Analysis 3.7; Analysis 3.8).

Please see Table 4 for a summary of results of the subgroup analysis.

Sensitivity analysis

A sensitivity analysis included only studies of high quality (studies for which both allocation concealment and Incomplete outcome data were rated as low risk) (see risk of bias table in Figure 4). Thirteen studies met the criteria for high quality (Boxall 2005; Cambach 1997; Cockcroft 1981; Emery 1998; Engström 1999; Goldstein 1994; Griffiths 2000; Karapolat 2007; Liu 2012; McNamara 2013; O'Shea 2007; Theander 2009; Van Wetering 2010). Effect estimates were consistent with overall summary effect estimates for the two primary outcomes when contributing data were restricted to high-quality studies, with the exception of one domain, for which the confidence interval widened enough to include the possibility of no difference between rehabilitation and control. All domains for both the CRQ and the SGRQ continued to be statistically significant when restricted to studies of high quality, with the exception of the SGRQ symptoms domain, which was no longer statistically significant (MD -4.12, 95% CI -8.42 to 0.21;, seven trials; 572 participants; $Tau^2 = 13.82$; $I^2 = 46\%$).

Neither subgroup analyses nor the sensitivity analysis based on quality had any impact on reducing or explaining high levels of heterogeneity.

DISCUSSION

This review summarised 65 studies involving 3822 participants with chronic obstructive pulmonary disease (COPD), 2090 of whom were randomly allocated to some form of exercise rehabilitation for a minimum duration of four weeks, and 1732 individuals randomly assigned to usual care. This is the second update of this review, which was last updated in 2006 (Lacasse 2006). Pulmonary rehabilitation is now accepted within the scientific community as an essential strategy in the ongoing management of people with COPD (GOLD 2014). Development of objective health-related quality of life (HRQoL) outcome measures (Kirshner 1985) and demonstration of a physiological rationale for exercise training in people with COPD (Casaburi 1991; Maltais 1996) have facilitated this acceptance. Results of the previous version of this meta-analysis strongly supported pulmonary rehabilitation (PR) in the management of COPD, and results of this current update reconfirm these findings.

Three aspects of the meta-analysis warrant comment. First, we examined the short-term effects of PR in COPD, that is, the benefits of rehabilitation found at the completion of a programme. When the original review was undertaken, few investigators were examining the long-term benefits of rehabilitation (Guell 2000; Ries 1995; Troosters 2000; Wijkstra 1995). More recently, focus on this aspect of PR has increased and exploration of strategies to maintain early benefits continues (Brooks 2002; Foglio 2001; Ries 2003). This review does not attempt to examine these issues. Second, we have been conservative in concluding clear benefit only when the 95% confidence interval (CI) representing the smallest treatment effect was still greater than the minimal clinically important difference (MCID). Third, we excluded a number of well-conducted studies that have contributed to our understanding of PR, but in which control participants received interventions beyond what was considered conventional care. An example of this is Ries 1995, which was excluded on the grounds that control participants had been given an educational programme. Similarly, several studies in which an intervention such as inspiratory muscle training, psychosocial support or breathing exercises was compared with exercise training were excluded. Only studies in which usual care was directly compared with exercise rehabilitation were included for analysis.

As the care of patients with COPD is largely concerned with treating symptoms (Pauwels 2001), we believe that HRQoL should be considered as the primary outcome in PR. The present meta-analysis reconfirms the findings of the previous version that PR is effective in relieving dyspnoea and fatigue, and in improving patients' emotional function and control over the disease. The magnitude of the improvement lies beyond the MCID.

In most trials, investigators measured HRQoL by using either the Chronic Respiratory Disease Questionnaire (CRQ) or the St. George's Respiratory Questionnaire (SGRQ). Head-to-head comparisons of these questionnaires have been published (Harper 1997; Rutten-van Mölken 1999). In both studies, analyses of reliability, validity and responsiveness did not clearly favour one

instrument above the other. Rutten-van Mölken and colleagues (Rutten-van Mölken 1999) suggested that the choice between the CRQ and the SGRQ should be based on other considerations, such as the required sample size. Only one trial included in the meta-analysis reported results from both the CRQ and the SGRQ (Griffiths 2000), with no clear indication that one questionnaire is more sensitive to change than the other. Therefore, comparisons from this meta-analysis are only indirect. We found wider 95% CIs around the pooled treatment effect from the SGRQ - a situation that may be explained by the smaller number of participants contributing to this analysis.

Pulmonary rehabilitation programmes included in the meta-analysis differed in several aspects, including clinical setting, duration and composition. This we believe is responsible for the substantial heterogeneity observed in the results obtained and is in keeping with a recent study by Spruit 2014 and supported by Rochester 2014, who also identified this as an issue requiring further investigation. For instance, the contributions of educational activities and psychological support to exercise training remain uncertain. This information would be of outmost importance to physicians and allied healthcare professionals who prescribe rehabilitation and to those who allocate the resources. We addressed this issue in a systematic overview of the literature (Lacasse 1997). Since the time this review was published, further evidence from randomised controlled trials (RCTs) has been published to better define the type and intensity of exercise (Bernard 1999), as well as the influence of programme components, including patient education and self-management (Bourbeau 2003), nutritional support (Steiner 2003) and respiratory muscle training (Watson 1997). Sometimes, evidence even took the form of systematic reviews (Ferreira 2012; Lotters 2002; Taylor 2005). Such questions were too specific to be directly addressed in this meta-analysis, which aimed to investigate the overall effect of rehabilitation in COPD (not the effects of its components). Nevertheless, homogeneity among study results suggested that less sophisticated rehabilitation programmes may also be effective in improving HRQoL, although the between-study comparison from which this conclusion follows is relatively weak.

Investigators have identified an increase in exercise tolerance and functional activities such as walking as other relevant outcomes of rehabilitation (Fishman 1994; Pauwels 2001). Our current interpretation of the results of the six-minute walk test (6MWT) analysis differs from that of the previous version of the meta-analysis (Lacasse 2006). In 2006, results of the meta-analysis were compared with an MCID of 54 metres (95% CI 37 to 71 metres; Redelmeier 1997). From this comparison, the clinical significance of results obtained from the 2006 meta-analysis was interpreted as uncertain. Since 2006, several studies have further investigated the issue of the MCID in field walk tests in chronic respiratory disease. Results of these studies have recently been summarised in an important systematic review, which was supported by the European Respiratory and American Thoracic Societies (Holland 2014; Singh 2014). Although variability across studies and methods used to determine the MCID is evident, available evidence suggests that the MCID for the 6MWT lies between 25 and 33 metres (median estimate 30 metres). Results of our meta-analysis (i.e. MD of 43.93 metres with 95% CI between 36.24 and 55.21 metres) indicate the clinical significance of the effects of PR.

When compared with the treatment effects of other important modalities of care for patients with COPD, such as long-acting inhaled therapy or oral theophylline and its new derivatives (Kew 2014 ; Ram 2005), rehabilitation resulted in greater improvement in important domains of HRQoL and functional exercise capacity.

The importance of measures of maximal exercise capacity remains to be defined. An initial test may be useful in assisting with the prescription of an appropriate level of training. Retesting may provide physiological evidence that a training response has occurred and may be useful in adjustment of intensity levels during the programme (Jones 1988). As the results of maximal exercise tests correlate poorly with those of HRQoL measures (Guyatt 1985; Wijkstra 1994a), maximal exercise testing cannot serve as a substitute for such measures when the outcome of a rehabilitation programme is evaluated.

AUTHORS' CONCLUSIONS

Implications for practice

Results of this meta-analysis strongly support pulmonary rehabilitation, including at least four weeks of exercise training, as part of the spectrum of treatment for patients with COPD. We found clinically and statistically significant improvements in important domains of health-related quality of life, including dyspnoea, fatigue, emotional function and mastery, in addition to the six-minute walk/distance test - a measure of functional exercise.

Pulmonary rehabilitation has long been underused in patients with COPD (Brooks 2007; Puhan 2011(a); Yohannes 2004). With the support of current international statements or clinical practice guidelines targeting respiratory rehabilitation in COPD (Bolton 2013; Nici 2006; Spruit 2013), we hope that the results of this meta-analysis will encourage the implementation of new programmes.

Implications for research

Overall, the conclusions of this meta-analysis are in agreement with those of prior meta-analyses published in 1996 and in 2001 (Lacasse 1996; Lacasse 2001). The addition of 34 RCTs since the 2006 update resulted, as expected, in narrowing of the CIs around the common effects of rehabilitation in the outcomes examined. This update continues to support the strong argument that PR is beneficial in improving HRQoL. It also reiterates the view presented in the 2006 update that additional RCTs comparing PR and conventional care in COPD are no longer warranted. However findings of the subgroup analysis undertaken as part of this update do stimulate new questions in relation to PR. The subgroup analysis finding that identified a difference in treatment effect between hospital-based programmes and community-based programmes suggests that further research should be undertaken to compare these two approaches. Similarly, the fact that the subgroup analysis identified no differences between basic exercise PR programmes and those that provided more complex interventions suggests the need to examine and identify the most essential components of PR programmes for achieving the best patient outcomes. Other factors that remain uncertain include the degree of supervision, the intensity of the training and how long the treatment effect persists. Recent recommendations provided by current guidelines from the ATS or ACSM that at least three weekly sessions are necessary for a treatment effect raise issues that require consideration beyond this

current review. These specific issues demand further elucidation through RCTs and further meta-analysis.

ACKNOWLEDGEMENTS

We acknowledge the authors of the primary studies included in the meta-analysis, who have kindly provided additional data and information regarding their previous work. We acknowledge the contributions of Eric Wong, Roger Goldstein and Gordon Guyatt, who co-authored the initial version of this review. We would also like to thank Elizabeth Stovold (CAG Information Specialist) for conducting electronic literature searches, Emma Jackson for assisting with locating papers and Emma Welsh for providing assistance during the editorial process.

Yves Lacasse acknowledges Merck Frosst Canada, who funded a co-author, Sylvie Martin, to work on a previously published version of the review. At the time, the Cochrane Airways Group did not believe that this funding presented a threat to the validity of the Reviews' findings. Merck Frosst Canada was not otherwise involved in the design or conduct of this meta-analysis. We also acknowledge Nederlands Astma Fonds, Netherlands for funding for an earlier version of this review. No authors received funding for the 2015 update of the review.

John White was the Editor for this review and commented critically on the review.

The methods section of this review is based on a standard template used by the Cochrane Airways Group.

REFERENCES

References to studies included in this review

Barakat 2008 *{published data only}*

Barakat S, Michele G, George P, Nicole V, Guy A. Outpatient pulmonary rehabilitation in patients with chronic obstructive pulmonary disease. *International Journal of COPD* 2008;**3**(1):155-62.

Baumann 2012 *{published data only}*

Baumann HJ, Kluge S, Rummel K, Klose HF, Hennigs JK, Schmoller T, et al. Low intensity, long-term outpatient rehabilitation in COPD: a randomised controlled trial. *Respiratory Research* 2012;**13**(1):86.

Behnke 2000a *{published data only}*

Behnke M. The effects of a home-based exercise training programme in patients with chronic obstructive lung disease [Die Wirkungen eines häuslichen Belastungstrainings bei Patienten mit chronisch-obstruktiver Lungenerkrankung]. *Pneumologie* 1999;**53**:2-3.

Behnke M, Jörres RA, Kirsten D, Magnussen H. Clinical benefits of a combined hospital and home-based exercise programme over 18 months in patients with severe COPD. *Monaldi Archives for Chest Disease* 2003;**59**(1):44-51.

Behnke M, Kirsten D, Jörres RA, Magnussen H. Home-based exercise training in patients with severe COPD-global effects. *American Journal of Respiratory and Critical Care Medicine* 2000;**161**(3 Suppl):A254.

Behnke M, Kirsten D, Lehnigk B, Jörres RA, Magnussen H. The effects of home-based exercise training on walking distance and quality of life in patients with severe COPD. *European Respiratory Journal* 1998;**12**(Suppl 38):3S.

Behnke M, Taube C, Kirsten D, Jörres RA, Lehnigk B, Magnussen H. The long-term effects of domestic walking training in patients with severe COPD [Die Langzeitwirkungen eines häuslichen Gehtrainings bei Patienten mit schwergradiger COPD]. *Pneumologie* 2000;**54**(S56):P77.

* Behnke M, Taube C, Kirsten D, Lehnigk B, Jörres RA, Magnussen H. Home-based exercise is capable of preserving hospital-based improvements in severe chronic obstructive pulmonary disease. *Respiratory Medicine* 2000;**94**:1184-91.

Bendstrup 1997 *{published data only}*

* Bendstrup KE, Ingemann Jensen J, Holm S, Bengtsson B. Out-patient rehabilitation improves activities of daily living, quality of life and exercise tolerance in chronic obstructive pulmonary disease. *European Respiratory Journal* 1997;**10**:2801-6.

Booker 1984 *{published data only}*

* Booker HA. Exercise training and breathing control in patients with chronic airflow limitation. *Physiotherapy* 1984;**70**:258-60.

Borghi-Silva 2009 *{published data only}*

Borghi-Silva A, Arena R, Castello V, Simoes RP, Martins LE, Catai AM, et al. Aerobic exercise training improves autonomic nervous control in patients with COPD. *Respiratory Medicine* 2009;**103**(10):1503-10.

Boxall 2005 *{published and unpublished data}*

Boxall A, Barclay L, Caplan G. A randomised controlled trial of home-based pulmonary rehabilitation for elderly, housebound COPD patients. Proceedings of the Thoracic Society of Australia & New Zealand Annual Scientific Meeting; 2003 4-9 April; Adelaide. 2003:P106.

* Boxall AM, Barclay L, Sayers A, Caplan GA. Managing chronic obstructive pulmonary disease in the community: a randomized controlled trial of home-based pulmonary rehabilitation for elderly housebound patients. *Journal of Cardiopulmonary Rehabilitation* 2005;**25**(6):378-85.

Busch 1988 *{published data only}*

* Busch AJ, McClements JD. Effects of a supervised home exercise program on patients with severe chronic obstructive pulmonary disease. *Physical Therapy* 1988;**68**:469-74.

Cambach 1997 *{published data only}*

Cambach W, Chadwick-Straver RVM, Wagenaar RC. The effects of a community-based pulmonary rehabilitation programme on exercise capacity and quality of life: a randomized controlled trial. *European Respiratory Journal* 1997;**10**(Suppl 25):394S.

Cambach W, Chadwick-Straver RVM, Wagenaar RC, van Keimpema ARJ. Efficacy of a rehabilitation programme in patients with asthma and chronic obstructive pulmonary disease (COPD) [Effectiviteit van een revalidatieprogramma voor patienten met astma en COPD uitgevoerd in de eerstelijnsgozondheidszorg]. *Nederlands Tijdschrift Fysiotherapie* 1998;**108**(2):26-36.

* Cambach W, Chadwick-Straver RVM, Wagenaar RC, van Keimpema ARJ, Kemper HCG. The effects of a community-based pulmonary rehabilitation programme on exercise tolerance and quality of life: a randomized controlled trial. *European Respiratory Journal* 1997;**10**:104-13.

Casaburi 2004 *{published data only}*

* Casaburi R, Bhasin S, Cosentino L, Porszasz J, Somfay A, Lewis MI, et al. Effects of testosterone and resistance training in men with chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine* 2004;**170**:870-8.

Casaburi R, Cosentino G, Bhasin S, Fournier M, Lewis M, Porszasz J, et al. A randomised trial of strength training and testosterone supplementation in men with chronic obstructive pulmonary disease. *European Respiratory Journal* 2001;**18**(Suppl 33):173S.

Chavoshan B, Fournier M, Lewis MI, Porszasz J, Storer TW, Da X, et al. Testosterone and resistance training effects on muscle nitric oxide synthase isoforms in COPD men. *Respiratory Medicine* 2012;**106**(2):269-75.

Casey 2013 *{published data only}*

Casey D, Murphy K, Devane D, Cooney A, McCarthy B, Mee L, et al. The effectiveness of a structured education pulmonary rehabilitation programme for improving the health status of people with moderate and severe chronic obstructive pulmonary disease in primary care: the PRINCE cluster randomised trial. *Thorax* 2013;**68**(10):922-8.

Casey, Murphy D, Cooney A, Mee L. Developing a structured education programme for clients with COPD. *British Journal of Community Nursing* 2011;**16**(5):231-7.

Murphy K, Casey D, Devane D, Cooney A, McCarthy B, Mee L, et al. The effectiveness of a structured education pulmonary rehabilitation programme for improving the health status of people with chronic obstructive pulmonary disease (COPD): the PRINCE study [Abstract]. *Irish Journal of Medical Science* 2011;**180**(Suppl 12):S457.

Murphy K, Casey D, Devane D, Cooney A, McCarthy, B, Mee L, et al. A cluster randomised controlled trial evaluating the effectiveness of a structured pulmonary rehabilitation education programme for improving the health status of people with chronic obstructive pulmonary disease (COPD): the PRINCE Study protocol. *BMC Pulmonary Medicine* 2011;**11**:4.

Cebollero 2012 *{published and unpublished data}*

Cebollero P, Zambon F, Hernandez M, Gorostiaga E, Ibanez J, Hueto J, et al. Effects of exercise twice a week in the peripheral muscle dysfunction in COPD patients. *American Journal of Respiratory and Critical Care Medicine [Abstract]* 2012;**185**(Meeting Abstracts):A4854.

Chan 2011 *{published data only}*

Chan AW, Lee, K, Suen A, Tam LKP, Tam WW. Tai chi Qigong improves lung functions and activity tolerance in COPD clients: a single blind, randomized controlled trial. *Complementary Therapies in Medicine* 2011;**19**(1):3-11.

Chlumsky 2001 *{published data only}*

Chlumsky J, Sterbova L, Smolikova L, Matous M, Salajka F. The effect of pulmonary rehabilitation on exercise tolerance and quality of life in patients with COPD. Preliminary data. *European Respiratory Journal* 2001;**18**(Suppl):223S.

Clark 1996 *{published data only}*

* Clark CJ, Cochrane L, Mackay E. Low intensity peripheral muscle conditioning improves exercise tolerance and breathlessness in COPD. *European Respiratory Journal* 1996;**9**(12):2590-6.

Cochrane 2006 *{published and unpublished data}*

Afolabi G, Watson B, Cochrane W, Dogan S, Heatley M. A study of the effectiveness of individual components of pulmonary rehabilitation when compared with the combined programme and standard treatment [Abstract]. *European Respiratory Journal* 2004;**24**(Suppl 48):209s.

Cochrane WC, Watson B, Dogan S, Afolabi OA, McAlpine C, Heatley M. Exercise training leads to a broader reduction in community and hospital service utilisation, compared with other forms of rehabilitation, after 6-months [Abstract]. American Thoracic Society 100th International Conference; 2004 May 21-26; Orlando. 2004:D96 Poster 128.

* Cochrane WC, Watson B, Dogan S, Heatley M, McAlpine C, Dovey-Pearce G, et al. A study of the effectiveness of individual components of pulmonary rehabilitation when compared with the combined programme and standard treatment. Final Report. Final Report Northumbria University and Northumbria Healthcare NHS Trust November 2006.

Cockcroft 1981 *{published data only}*

Cockcroft A, Berry G, Brown EB, Exall C. Psychological changes during a controlled trial of rehabilitation in chronic respiratory disability. *Thorax* 1982;**37**:413-6.

* Cockcroft AE, Saunders MJ, Berry G. Randomised controlled trial of rehabilitation in chronic respiratory disability. *Thorax* 1981;**36**:200-3.

Deering 2011 *{published and unpublished data}*

Deering BM, Fullen B, Egan C, McCormack N, Kelly E, Pender M, et al. Acupuncture as an adjunct to pulmonary rehabilitation. *Journal of Cardiopulmonary Rehabilitation and Prevention* 201;**31**(6):392-99.

De Souto Araujo 2012 *{published and unpublished data}*

de Souto Araujo ZT, de Miranda Silva Nogueira PA, Cabral EE, de Paula Dos Santos LD, da Silva IS, Ferreira GM. Effectiveness of low-intensity aquatic exercise on COPD: a randomized clinical trial. *Respiratory Medicine* 2012;**106**(11):1535-43.

Elci 2008 *{published data only}*

Elci A, Borekci S, Ovayolu N, Elbek O. The efficacy and applicability of a pulmonary rehabilitation programme for patients with COPD in a secondary-care community hospital. *Respirology* 2008;**13**(5):703-7.

Emery 1998 *{published data only}*

* Emery CF, Schein RL, Hauck ER, MacIntyre NR. Psychological and cognitive outcomes of a randomised trial of exercise among patients with chronic obstructive pulmonary disease. *Health Psychology* 1998;**17**:232-40.

Engström 1999 *{published data only}*

* Engström CP, Persson LO, Larsson S, Sullivan M. Long-term effects of a pulmonary rehabilitation programme in outpatients with chronic obstructive pulmonary disease: a randomized controlled study. *Scandinavian Journal of Rehabilitation Medicine* 1999;**31**:207-13.

Faager 2004 *{published data only}*

Faager G, Larsen FF. Performance changes for patients with chronic obstructive pulmonary disease on long-term oxygen therapy after physiotherapy. *Journal of Rehabilitation Medicine* 2004;**36**(4):153-8.

Faulkner 2010 *{published and unpublished data}*

Faulkner J, Walshaw E, Campbell J, Jones R, Taylor R, Price, et al. The feasibility of recruiting patients with early COPD to a pilot trial assessing the effects of a physical activity intervention. *Primary Care Respiratory Journal* 2010;**19**:124-30.

Fernandez 2009 *{published data only}*

Fernandez AM, Pascual J, Ferrando C, Arnal A, Vergara I, Sevila V. Home-based pulmonary rehabilitation in very severe COPD: is it safe and useful?. *Journal of Cardiopulmonary Rehabilitation and Prevention* 2009;**29**(5):325-31.

Finnerty 2001 *{published data only}*

* Finnerty JP, Keeping I, Bullough I, Jones J. The effectiveness of outpatient pulmonary rehabilitation in chronic lung disease. A randomized controlled trial. *Chest* 2001;**119**:1705-10.

Gohl 2006 *{published data only}*

Gohl O, Linz H, Schonleben T, Otte B, Weineck J, Worth H. [Benefits of a multimodular outpatient training program for patients with COPD]. [German]. *Pneumologie* 2006;**60**(9):529-36.

Goldstein 1994 *{published data only}*

Goldstein RS, Gort EH, Guyatt GH, Feeny D. Economic analysis of respiratory rehabilitation. *Chest* 1997;**112**(2):370-9.

* Goldstein RS, Gort EH, Stubbing D, Avendano MA, Guyatt GH. Randomised controlled trial of respiratory rehabilitation. *Lancet* 1994;**344**:1394-7.

Gort EH, Goldstein R, Guyatt G, Stubbing D, Avendano M. Randomized controlled trial of respiratory rehabilitation. *Canadian Journal of Rehabilition* 1993;**7**(1):13-4.

Guyatt GH, King DR, Feeny DH, Stubbing D, Goldstein RS. Generic and specific measurement of health-related quality of life in a clinical trial of respiratory rehabilitation. *Journal of Clinical Epidemiology* 1999;**52**(3):187-92.

Gomez 2006 *{published data only}*

Gomez A, Roman M, Larraz C, Esteva M, Mir I, Thomás V. Efficacy of respiratory rehabilitation on patients with moderate COPD in primary care and maintenance of benefits at 2 years. *Aten Primaria* 2006;**38**:230-33.

Roman M, Concepcion L, Gomez A, Ripoll J, Mir I, Miranda EZ, et al. Efficacy of pulmonary rehabilitation in patients with moderate chronic obstructive pulmonary disease: a randomized controlled trial. http://www.biomedcentral.com/1471-2296/14/21 (accessed 21 October 2014).

Gosselink 2000 *{published data only}*

Gosselink R, Troosters T, Houtmeyers E, Decramer M. Adaptations in breathing pattern after exercise training in patients with COPD. *American Journal of Respiratory and Critical Care Medicine* 1998;**157**(Suppl 3):A257.

Gosselink R, Troosters T, Rollier H, Decramer M. Improved exercise capacity after out-patient pulmonary rehabilitation in COPD patients. *European Respiratory Journal* 1996;**9**(Suppl 23):383S.

Gosselink R, Troosters T, Rollier H, Decramer M. Pulmonary rehabilitation improves exercise capacity in COPD: preliminary results. *European Respiratory Journal* 1995;**8**(Suppl 19):356S.

* Troosters T, Gosselink R, Decramer M. Short and long-term effects of outpatient rehabilitation in patients with chronic obstructive pulmonary disease: a randomized trial. *American Journal of Medicine* 2000;**109**:207-12.

Gottlieb 2011 *{published data only}*

Gottlieb V, Lyngsø AM, Nybo B, Frølich A, Backer V. Pulmonary rehabilitation for moderate COPD (GOLD 2) - does it have an effect?. *COPD* 2011;**8**(5):380-6.

Griffiths 2000 *{published data only}*

* Griffiths TL, Burr ML, Campbell IA, Lewis-Jenkins V, Mullins J, Shiels K, et al. Results at 1 year of outpatient multidisciplinary pulmonary rehabilitation: a randomised controlled trial. *The Lancet* 2000;**355**:362-8.

Griffiths TL, Phillips CJ, Davies S, Burr ML, Campbell IA. Cost effectiveness of an outpatient multidisciplinary pulmonary rehabilitation programme. *Thorax* 2001;**56**(10):779-84.

Güell 1995 *{published and unpublished data}*

Güell R, Casan P, Belda J, Sangenis M, Morante F. Effect of maintenance techniques on outcomes in a respiratory rehabilitation programme in COPD patients. *Archivos de Bronconeumología* 1997;**33**(Suppl 1):6.

* Güell R, Casan P, Belda J, Sangenis M, Morante F, Guyatt GH, et al. Long-term effects of outpatient rehabilitation of COPD: a randomized trial. *Chest* 2000;**117**(4):976-83.

Güell R, Casan P, Belda J, Sangenis M, Morante F, Sanchis J. Effects of maintenance techniques on the results obtained in a respiratory rehabilitation programme for COPD patients. *European Respiratory Journal* 1997;**10**(Suppl 25):394S.

Güell R, Casan P, Sangenis M, Morante F, Belda J, Guyatt GH. Quality of life in patients with chronic respiratory disease: the Spanish version of the Chronic Respiratory Questionnaire (CRQ). *European Respiratory Journal* 1998;**11**(1):55-60.

Güell R, Morante F, Sangenis M, et al. Effects of respiratory rehabilitation on the effort capacity and on the health-related quality of life of patients with chronic obstructive pulmonary disease. *European Respiratory Journal* 1995;**8**(Suppl):356.

Güell R, Morante F, Sangenís M, Casan P. Effects of respiratory rehabilitation on quality of life of patients with chronic obstructive pulmonary disease. *Annals de Medicina* 1995;**81**(1):9.

Güell 1998 *{unpublished data only}*

Guell R, Resqueti V, Sangenis M, Morante F, Martorell B, Casan P, et al. Impact of pulmonary rehabilitation on psychosocial morbidity in with severe COPD. *Chest* 2006;**129**(4):899-904.

Güell R, Gonzalez Y, Gonzalez A, Sotomayor C, Sangenis M, Morante F, et al. Impact of respiratory rehabilitation on personality traits and characteristics of patients with COPD. *Archivos de Bronconeumología* 1998;**34**(Suppl 1):34.

* Güell R, Gonzalez Y, Martorell B, Gonzalez A, Sotomayor C, Sangenis M, et al. Impact of pulmonary rehabilitation on personality traits and styles in COPD patients. *European Respiratory Journal* 1998;**12**(Suppl 28):228S.

Gurgun 2013 *{published data only}*

Gurgun A, Deniz S, Argin M, Karapolat H. Effects of nutritional supplementation combined with conventional pulmonary rehabilitation in muscle-wasted chronic obstructive pulmonary disease: a prospective, randomized and controlled study. *Respirology* 2013;**18**(3):495-500.

Gurgun A, Deniz S, Argyn M, Karapolat H. The effects of nutritional supplementation added to pulmonary rehabilitation in muscle wasted chronic obstructive pulmonary disease: a randomised, controlled, prospective study [Abstract]. *American Journal of Respiratory and Critical Care Medicine* 2011;**183**(Meeting Abstracts):A3972.

Hernandez 2000 *{published data only}*

Cejudo P, Elias T, Montemayor T, Ortega F, Sanchez H, Villagomez R. Results of a home-based training program applied to patients with chronic obstructive pulmonary disease (COPD). European Respiratory Society 9th Annual Congress; 1999 Oct 9-13; Madrid. 1999:210.

Elias M, Ortega F, Toral J, Sanchez H, Cejudo P, Montemayor T. Improvement in exercise tolerance and quality of life in COPD patients following a home training programme. *Archivos De Bronconeumologia* 1998;**34**(Suppl 1):34.

Elias M, Ortega F, Toral J, Tabernero E, Sanchez H, Montemayor T. Evaluation of a home training programme in patients with COPD (preliminary results). *Archivos De Bronconeumologia* 1997;**33**(Suppl 1):12.

Elias MT, Ortega F, Toral J, Sanchez H, Cejudo P, Montemayor T. Results from a home-based exercise training program in patients with COPD [Resultados de un programa domiciliario de entrenamiento al ejercicio en pacientes con EPOC]. *Neumosur* 1998;**10**(1):16-7.

Elías MT, Ortega F, Toral J, Sánchez H, Cejudo P, Montemayor T. Improvement in exercise tolerance and quality of life in COPD patients following a home training programme [Mejoria en la tolerancia al ejercico y en la calidad de vida en pacientes EPOC tras un programa de entrenamiento domiciliario]. *Archivos de Bronconeumologìa* 1998;**34**(Suppl 1):34.

Elías MT, Ortega F, Toral J, Tabernero E, Sánchez H, Montemayor T. Evaluation of a home training programme in patients with COPD (preliminary results) [Evaluación de un programa de entremiento domiciliaro en pacientes con EPOC (resultados perliminares)]. *1997* Archivos de Bronconeumología;**33**(Suppl 1):12.

* Hernandez MT, Rubio TM, Ruiz FO, Riera HS, Gil RS, Gomez JC. Results of a home-based training program for patients with COPD. *Chest* 2000;**118**:106-14.

Hoff 2007 *{published data only}*

Hoff J, Tjonna AE, Steinshamn S, Hoydal M, Richardson RS, Helgerud J. Maximal strength training of the legs in COPD: a therapy for mechanical inefficiency. *Medicine and Science in Sports and Exercise* 2007;**39**(2):220-6.

Jones 1985 *{published data only}*

* Jones DT, Thomson RJ, Sears MR. Physical exercise and resistive breathing in severe chronic airways obstruction - are they effective?. *European Journal of Respiratory Diseases* 1985;**67**:159-66.

Karapolat 2007 *{published data only}*

Karapolat H, Atasever A, Atamaz F, Kirazli J, Elmas F, Erdinc E. Do the benefits gained using a short-term pulmonary rehabilitation program remain in COPD patients after participation?. *Lung* 2007;**185**:221-5.

Lake 1990 *{published data only}*

* Lake FR, Henderson K, Briffa T, Openshaw J, Musk AW. Upper-limb and lower-limb exercise training in patients with chronic airflow obstruction. *Chest* 1990;**97**:1077-82.

Lindsay 2005 *{published data only (unpublished sought but not used)}*

Lindsay M, Lee A, Chan K, Poon P, Han LK, Wong WC, et al. Does pulmonary rehabilitation give additional benefit over tiotropium therapy in primary care management of chronic obstructive pulmonary disease? Randomized controlled clinical trial in Hong Kong Chinese. *Journal of Clinical Pharmacy and Therapeutics* 2005;**30**(6):567-73.

Lindsay M, Lee A, Poon P, Han LK, Wong WC, Wong W, et al. Does pulmonary rehabilitation give additional benefits to primary care patients with chronic obstructive pulmonary disease? Results from randomized controlled clinical trial in Hong Kong [Abstract]. *Respirology* 2004;**9**(Suppl):A100.

Liu 2012 *{published data only}*

Liu XD, Jin HZ, Ng Bh- P, Gu YH, Wu Y-C, Lu G. Therapeutic effects of qigong in patients with COPD: a randomized controlled trial. *Hong Kong Journal of Occupational Therapy* 2012;**22**(1):38-46.

McGavin 1977 *{published data only}*

McGavin CR, Gupta SP, Lloyd EL, McHardy GJR. A controlled trial of self-regulated physical training in chronic bronchitis. *British Journal of Diseases of the Chest* 1976;**70**(4):278.

* McGavin CR, Gupta SP, Lloyd EL, McHardy GJR. Physical rehabilitation for the chronic bronchitis: results of a controlled trial of exercises in the home. *Thorax* 1977;**32**:307-11.

McNamara 2013 *{published and unpublished data}*

McNamara RJ, Alison JA, McKenzie DK, McKeough ZJ. Water-based exercise improves exercise capacity in people with COPD with physical co-morbid conditions [Abstract]. *Respirology* 1010;**15**(Suppl 1):A24 [TO 056].

McNamara RJ, McKeough ZJ, McKenzie DK, Alison JA. Water-based exercise in COPD with physical comorbidities: a randomised controlled trial. *European Respiratory Journal* 2013;**6**:1284-91.

McNamara, RJ, Alison JA, McKenzie DK, McKeough ZJ. Water-based exercise in people with COPD and physical co-morbid conditions: a randomised controlled trial [Abstract]. European Respiratory Society 20th Annual Congress; 2010 Sep 18-22; Barcelona. 2010:181.

Mehri 2007 *{published data only}*

Mehri SN, Khoshnevis MA, Zarrehbinan F, Hafezi S, Ghasemi A, Ebadi A. Effect of treadmill exercise training on VO2 peak in chronic obstructive pulmonary disease. *Tanaffos* 2007;**6**(4):18-24.

Mendes De Oliveira 2010 *{published and unpublished data}*

Mendes De Oliveira JC, Studart Leitao Filho FS, Malosa Sampaio LM, Negrinho De Oliveira AC, Hirata RP, Costa D, et al. Outpatient vs. home-based pulmonary rehabilitation in COPD: a randomized controlled trial. *Multidisciplinary Respiratory Medicine* 2010;**5**(6):401-8.

de Oliveira JCM, Filho FSL, Sampaio L, Oliveira AC, Hirata R, Costa D. Outpatient vs. home-based pulmonary rehabilitation in COPD: A randomized controlled trial [Abstract]. *European Respiratory Society 21st Annual Congress; 2011 Sep 24-28; Amsterdam* 2011;**38**(55):879s [P4805].

Nalbant 2011 *{published data only (unpublished sought but not used)}*

Nalbant O, Nur H, Ogus C, Toraman NF. Effects of long-term aerobic exercise program in chronic obstructive pulmonary disease. *Turkiye Fiziksel Tip ve Rehabilitasyon Dergisi* 2011;**57**(1):8-13.

O'Shea 2007 *{published data only}*

O' Shea SD, Taylor NF, Paratz J. Peripheral strength training for people with chronic obstructive pulmonary disease [Abstract]. *Respirology* 2005;**10**(suppl):A58.

* O'Shea SD, Taylor NF, Paratz JD. A predominantly home-based progressive resistance exercise program increases knee extensor strength in the short-term in people with chronic obstructive pulmonary disease: a randomised controlled trial. *Australian Journal of Physiotherapy* 2007;**53**(4):229-37.

O'Shea SD, Taylor NF, Paratz JD. Peripheral strength training for people with chronic obstructive pulmonary disease: a randomised controlled trial. [abstract]. *Australian Journal of Physiotherapy* 2006;**52**(2):s22.

O'Shea SD, Taylor NF, Paratz JD. Qualitative outcomes of progressive resistance exercise for people with COPD. *Chronic Respiratory Disease* 2007;**4**(3):135-42.

Ozdemir 2010 *{published data only}*

Ozdemir EP, Solak O, Fidan F, Demirdal US, Evcik, D, Unlu M, et al. The effect of water-based pulmonary rehabilitation on anxiety and quality of life in chronic pulmonary obstructive disease patients. *Turkiye Klinikleri Journal of Medical Sciences* 2010;**30**(1):880-7.

Paz-Diaz 2007 *{published data only}*

Paz-Diaz H, Montes de Oca M, Lopez JM, Celli BR. Pulmonary rehabilitation improves depression, anxiety, dyspnea and health status in patients with COPD. *American Journal of Physical Medicine and Rehabilitation* 2007;**86**(1):30-6.

Petty 2006 *{published data only}*

Petty TL, Dempsey EC, Collins T, Pluss W, Lipkus I, Cutter GR, et al. Impact of customized videotape education on quality of life in patients with chronic obstructive pulmonary disease. *Journal of Cardiopulmonary Rehabilitation* 2006;**26**(2):112-7.

Reardon 1994 *{published data only}*

* Reardon J, Awad E, Normandin E, Vale F, Clark B, ZuWallack RL. The effect of comprehensive outpatient pulmonary rehabilitation on dyspnea. *Chest* 1994;**105**:1046-52.

Ringbaek 2000 *{published data only}*

Broendum E, Lybeck K, Andersen C, Hemmingsen L, Nielsen D, Lange P, et al. Rehabilitation in patients with COPD - the effect of a "twice-a-week-programme". European Respiratory Society 9th Annual Congress; 1999 Oct 9-13; Madrid. 1999:208.

* Ringbaek TJ, Broendum E, Hemmingsen L, Lybeck K, Nielsen D, Andersen C, et al. Rehabilitation of patients with chronic obstructive pulmonary disease. Exercise twice a week is not sufficient!. *Respiratory Medicine* 2000;**94**(2):150-4.

Simpson 1992 *{published data only}*

* Simpson K, Killian K, McCartney N, Jones NL. Randomised controlled trial of weightlifting exercise in patients with chronic airflow limitation. *Thorax* 1992;**47**:70-5.

Singh 2003 *{published data only}*

* Singh V, Khandelwal DC, Khandelwal R, Abusaria S. Pulmonary rehabilitation in patients with chronic obstructive pulmonary diseases. *Indian Journal of Chest Diseases and Allied Sciences* 2003;**45**(1):13-7.

Sridhar 2008 *{published data only}*

Sridhar M, Taylor R, Dawson S, Roberts NJ, Partridge MR. A nurse led intermediate care package in patients who have been hospitalised with an acute exacerbation of chronic obstructive pulmonary disease. *Thorax* 2008;**63**(3):194-200.

Strijbos 1996 *{published data only}*

Strijbos JH, Koëter GH, Meinesz AF. Home care rehabilitation and perception of dyspnea in chronic obstructive pulmonary disease. *Chest* 1990;**97**(Suppl):109-10.

* Strijbos JH, Postma DS, van Altena R, et al. A comparison between an outpatient hospital-based pulmonary rehabilitation program and a home-care pulmonary rehabilitation program in patients with COPD. A follow-up of 18 months. *Chest* 1996;**109**(2):366-72.

Strijbos JH, Postma DS, van Altena R, Gimeno F, Koeter GH. Feasibility and effects of a home-care rehabilitation program in patients with chronic obstructive pulmonary disease. *Journal of Cardiopulmonary Rehabilitation* 1996;**16**(6):386-93.

Strijbos JH, Wijkstra PJ, Postma DS, Koeter GH. Five year effects of rehabilitation at different settings in patients with chronic obstructive pulmonary disease. European Respiratory Society 9th Annual Conference; 1999; Oct 9-13; Madrid. 1999:209.

Theander 2009 *{published data only}*

Theander K, Jakobsson P, Jorgensen N, Unosson M. Effects of pulmonary rehabilitation on fatigue, functional status and health perceptions in patients with chronic obstructive

pulmonary disease: a randomized controlled trial. *Clinical Rehabilitation* 2009;**23**(2):125-36.

Vallet 1994 *{published data only}*

* Vallet G, Varray A, Fontaine JL, Prefaut C. Interest of individualized training program at the ventilatory threshold in mild to moderate COPD patients [Intérêt du réentraînement à l'effort individualisé, au niveau du seuil ventilatoire, au cours de la bronchopneumopathie chronique obstructive de sévérité modérée]. *Revue des Maladies Respiratoires* 1994;**11**(5):493-501.

Van Wetering 2010 *{published data only}*

Hoogendoorn M, van Wetering CR, Schols AM, Rutten-van Molken MP. Is INTERdisciplinary Community-based COPD management (INTERCOM) cost effective?. *European Respiratory Journal* 2010;**35**:79-87.

Van Wetering CR, Hoogendoorn M, De Munck DR, Rutten-van Molken MP, Schols AM. Cost-effectiveness of a 24 month INTERdisciplinary COMmunity -based COPD management program (INTERCOM) in patients with less advanced airflow obstruction [Abstract]. American Thoracic Society International Conference, May 15-20, 2009, San Diego. 2009:A5373.

* Van Wetering CR, Hoogendoorn M, Mol SJ, Rutten-Van Molken M, Schols AM. Short- and long-term efficacy of a community-based COPD management programme in less advanced COPD: a randomised controlled trial. *Thorax* 65;**1**:7-13.

van Wetering CR, Hoogendoorn M, Broekhuizen R, Geraerts-Keeris GJ, De Munck DR, Rutten-van Mölken MP. Efficacy and costs of nutritional rehabilitation in muscle-wasted patients with chronic obstructive pulmonary disease in a community-based setting: a prespecified subgroup analysis of the INTERCOM trial. *Journal of the American Medical Directors Association* 2010;**11**(3):179-87.

van Wetering CR, van Nooten FE, Mol, SJ, Hoogendoorn M, Rutten-Van Molken MP, Schols AM. Systemic impairment in relation to disease burden in patients with moderate COPD eligible for a lifestyle program. Findings from the INTERCOM trial. *International Journal of COPD* 2008;**3**(3):443-51.

Vijayan 2010 *{published data only (unpublished sought but not used)}*

Vijayan VK, Senthil K, Menon B, Bansal V. Effect of pulmonary rehabilitation on markers of inflammation, muscle mass and exercise capacity in patients with chronic obstructive pulmonary disease (COPD) [Abstract]. 15th Congress of the Asian Pacific Society of Respirology; 2010 Nov 22-25; Manila. 2010.

Weiner 1992 *{published data only}*

* Weiner P, Azgad Y, Ganam R. Inspiratory muscle training combined with general exercise reconditioning in patients with COPD. *Chest* 1992;**102**:1351-6.

Wen 2008 *{published data only}*

Wen H, Gao Y, An JY. Comparison of high-intensity and anaerobic threshold programs in rehabilitation for patients with moderate to severe chronic obstructive pulmonary disease. [Chinese]. *Chung-Hua Chieh Ho Ho Hu Hsi Tsa Chih Chinese Journal of Tuberculosis & Respiratory Diseases* 2008;**31**(8):571-6.

Wijkstra 1994 *{published data only}*

Wijkstra PJ, Kraan J, Van der Mark THW, Van Altena R, Postama DS, Koeter GH. Long-term benefits of rehabilitation at home on inspiratory muscle function and dyspnoea in patients with chronic obstructive pulmonary disease (COPD). *European Respiratory Journal* 1994;**7**(Suppl 18):296S.

* Wijkstra PJ, Van Altena R, Kraan J, Otten V, Postma DS, Koëter GH. Quality of life in patients with chronic obstructive pulmonary disease improves after rehabilitation at home. *European Respiratory Journal* 1994;**7**:269-73.

Wijkstra PJ, van der Mark TW, Kraan J, van Altena R, Koeter GH, Postma DS. Long-term effects of home rehabilitation on physical performance in chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine* 1996;**153**(4 (pt 1)):1234-41.

Xie 2003 *{published data only}*

* Xie SL, Zhu MG, Cui HB, Liu HY. Influence of home-based training program on patients with COPD. *Zhonghua Linchuang Kangfu Zazhi* 2003;**7**(18):2554-5.

References to studies excluded from this review

Akinci 2011 *{published and unpublished data}*

Akinci AC, Olgun N. The effectiveness of nurse-led, home-based pulmonary rehabilitation in patients with COPD in Turkey. *Rehabilitation Nursing* 2011;**36**(4):159-65.

Ambrosino 1981 *{published data only}*

Ambrosino N, Paggiaro PL, Macchi M, Filieri M, Toma G, Lombardi FA, et al. A study of short-term effect of rehabilitative therapy in chronic obstructive pulmonary disease. *Respiration* 1981;**41**(1):40-4.

Ambrosino 2006 *{published data only}*

Ambrosino N, De Angelis G, Pasqua P, Paggiaro A, Cogo G, Balzano K, et al. Physiological and symptom correlates of exercise tolerance in COPD patient. American Thoracic Society International Conference; 2006 May 19-21; San Diego. 2006; Vol. A212 [Poster L78].

Amin 2011 *{published and unpublished data}*

Amin S, Quinn M, Abrazado M, Forster R, Berenc M, Storer T. Controlled feasibility study of a community-based exercise program In patients with moderate COPD. *American Journal of Respiratory and Critical Care Medicine* 2011;**183**(Meeting Abstracts):A5042.

Arnadottir 2001 *{published data only}*

* Arnardottir H, Larsson K, Ringqvist I, Sorensen S. Endurance training compared to non-endurance training in chronic obstructive pulmonary disease (COPD). A randomized controlled trial. *American Journal of Respiratory and Critical Care Medicine* 2001;**163**(Suppl 5):A647.

Arnrdottir H, Emtner M, Hedenstrom H, Larsson K, Boman G. Comparing interval and continuous endurance training in COPD. *European Respiratory Journal* 2005;**26**(Suppl 49):1694.

Backer 2003 *{published data only}*

* Backer V, Beyer N, Madsen MK, Jorgensen K, Larson L, Kjaer M. Resistance-training improves muscle strength, functional level and self-reported health in patients with chronic obstructive pulmonary disease [Abstract]. American Thoracic Society 99th International Conference; 2003 May 16-21; Seattle. 2003:C042, Poster C33.

Bauldoff 1996 *{published data only}*

* Bauldoff GS, Hoffman LA, Sciurba F, Zullo TG. Home-based, upper-arm exercise training for patients with chronic obstructive pulmonary disease. *Heart and Lung* 1996;**25**:288-94.

Bauldoff 2002 *{published data only}*

* Bauldoff GS, Hoffman LA, Zullo TG, Sciurba FC. Exercise maintenance following pulmonary rehabilitation: effect of distractive stimuli. *Chest* 2002;**122**(3):948-54.

Behnke 2002 *{published data only}*

Behnke M, Schwertfeger I, von Foreich, Robinson I, Jörres RA, Magnussen H. Monitoring home-based exercise training in patients with stable COPD. *American Journal of Respiratory and Critical Care Medicine* 2002;**165**(Suppl 8):A16.

Behnke 2002a *{published data only}*

Behnke M, Schwertfeger I, von Froreich K, Robinson I, Jörres RA, Magnussen H. Combined exercise programs in patients with stable COPD: influence of psychological profile and monitoring. *European Respiratory Journal* 2002;**20**(Suppl 38):18S.

Behnke 2003 *{published data only}*

Behnke M, Schwertfeger I, von Froreich K, Robinson I, Kirsten D, Joerres RA, et al. Psychological profile but not monitoring predicts the outcome of exercise programs in COPD. American Thoracic Society 99th International Conference; 2003 May 16-21; Seattle. 2003:C042, Poster C43.

Bernard 1999 *{published data only}*

Bernard S, Whittom F, Leblanc P, Jobin J, Belleau R, Berube C, et al. Aerobic and strength training in patients with chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine* 1999;**159**(3):896-901.

Berry 1996 *{published data only}*

Berry MJ, Adair NE, Sevensky KS, Quinby A, Lever HM. Inspiratory muscle training and whole-body reconditioning in chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine* 1996;**153**(6 (Pt 1)):1812-6.

Bjerre-Jepsen 1981 *{published data only}*

* Bjerre-Jepsen K, Secher NH, Kok-Jensen A. Inspiratory resistance training in severe chronic obstructive pulmonary disease. *European Journal of Respiratory Diseases* 1981;**62**(6):405-11.

Böhning 1990 *{published data only}*

* Bohning W, Wettengel R. Physical exercise training in COPD during a 4-week rehabilitation programme. *European Respiratory Journal* 1990;**3**(Suppl 10):212S.

Bourbeau 2000 *{published data only}*

Bourbeau J, Collet JP, Schwartzman K, Beaupre A, Begin R, Maltais F, et al. Integrating rehabilitative elements into a COPD self-management program reduces exacerbations and health service utilization: a randomized clinical trial. *American Journal of Respiratory and Critical Care Medicine* 2000;**161**(Suppl 3):A254.

Bourbeau J, Julien M, Rouleau M, Maltais F, Beaupré A, Bégin R. Impact of an integrated rehabilitative self-management program on health status of COPD patients: a multicentre randomised clinical trial. *European Respiratory Journal* 2000;**16**(Suppl 31):159S.

Bourjeily-Habr 2002 *{published data only}*

* Bourjeily-Habr G, Rochester CL, Palermo F, Snyder P, Mohsenin V. Randomised controlled trial of transcutaneous electrical muscle stimulation of the lower extremities in patients with chronic obstructive pulmonary disease. *Thorax* 2002;**57**(12):1045-9.

Breyer 2010 *{published data only}*

Breyer MK, Breyer-Kohansal R, Funk GC, Dornhofer N, Spruit MA, Wouters EF, et al. Nordic walking improves daily physical activities in COPD: a randomised controlled trial. *Respiratory Research* 2010;**11**:112.

Brooks 2000 *{unpublished data only}*

Brooks D, Krip B, Mangovski Alzamora S, Avendano M, Goldstein R. The influence of post-rehabilitation program on health related quality of life (HRQL) and functional exercise capacity in patients with chronic obstructive pulmonary disease (COPD). *American Journal of Respiratory and Critical Care Medicine* 2000;**161**(Suppl 3):A504.

Cai 2003 *{published data only}*

Cai H. Rehabilitation effect of combination of respiration exercise, Jinshuibao capsule and external application in stable stage of chronic obstructive pulmonary diseases. *Zhonghua Linchuang Kangfu Zazhi* 2003;**7**(5):877.

Carrieri-Kohlman 96 *{published data only}*

Carrieri-Kohlman V, Gormley JM, Douglas MK, Paul SM, Stulbarg MS. Exercise training decreases dyspnea and the distress and anxiety associated with it. Monitoring alone may be as effective as coaching. *Chest* 1996;**110**(6):1526-35.

Cegla 2002 *{published data only}*

* Cegla UH, Jost HJ, Harten A, Weber T, Wissmann S. Course of severe COPD with and without physiotherapy with the RC-Cornet®: a randomized 2 years long-term study. *Pneumologie* 2002;**56**(7):418-24.

Chen 2011 *{published data only}*

Chen G, Zhou X, Hu X, Liu Y, Li Q. Effect of exercise on the quality of life and pulmonary function in patients with chronic

obstructive pulmonary disease. *Zhong Nan da Xue Xue Bao. Yi Xue Ban [Journal of Central South University. Medical Sciences]* 2011;**36**(7):682-6.

Ciric 2008 *{published data only}*

Ciric Z, Stankovic I, Rancic M, Pejcic T, Radovic M. Pulmonary rehabilitation in patients with chronic obstructive pulmonary disease. *Vojnosanitetski Pregled* 2008;**65**(7):533-8.

Clark 2000 *{published data only}*

* Clark CJ, Cochrane LM, Mackay E, Paton B. Skeletal muscle strength and endurance in patients with mild COPD and the effects of weight training. *European Respiratory Journal* 2000;**15**(1):92-7.

Mackay EM, Clark CJ, Cochran LM, Bell F. The effect of a 12 week weight training programme in improving muscle endurance in patients with chronic obstructive pulmonary disease. 12th International Congress of the World Confederation of Physical Therapy; 1995; Washington DC. 1995; Vol. 30:430.

Cockcroft 1985 *{published data only}*

* Cockcroft A, Beaumont A, Guz A. Effect of exercise training on walking distance, exercise ventilation and breathlessness in patients with COAD. *Clinical Science* 1985;**69**(Suppl 12):7.

Coppoolse 1999 *{published data only}*

Coppoolse R, Schols A, Baarends EM, Mostert R, Akkermans MA, Janssen PP, et al. Interval versus continuous training in patients with severe COPD: a randomized clinical trial. *European Respiratory Journal* 1999;**14**(2):258-63.

Covey 2004 *{published data only}*

Covey MK, Larson JL. Exercise and COPD. *American Journal of Nursing* 2004;**104**(5):40-3.

Cox 1993 *{published data only}*

Cox NJ, Hendricks JC, Binkhorst RA, van Herwaarden CL. A pulmonary rehabilitation program for patients with asthma and mild chronic obstructive pulmonary diseases (COPD). *Lung* 1993;**171**(4):235-44.

de Blasio 2000 *{published data only}*

* De Blasio F. A doubting Thomas dealing with pulmonary rehabilitation. *Chest* 2000;**117**(4):929-31.

Dekhuijzen 1990 *{published data only}*

Dekhuijzen PNR, Beek MML, Folgering HTM, Van Herwaarden CLA. Psychological changes during pulmonary rehabilitation and target-flow inspiratory muscle training in COPD patients with a ventilatory limitation during exercise. *International Journal of Rehabilitation Research* 1990;**13**:109-17.

Dekhuijzen 1991 *{published data only}*

* Dekhuijzen PN, Folgering HT, van Herwaarden CL. Target-flow inspiratory muscle training during pulmonary rehabilitation in patients with COPD. *Chest* 1991;**99**(1):128-33.

Dekhuijzen PNR, Herwaarden van CLA, Folgering HThM. Target-flow inspiratory muscle training (IMT) increases inspiratory muscle strength and endurance [Abstract]. *European Respiratory Journal* 1989;**2**(Suppl):389S.

de Lucas Ramos 1998 *{published data only}*

de Lucas Ramos P, Rodriguez Gonzalez-Moro JM, Garcia de Pedro J, Santacruz Siminiani A, Tatay Marti E, Cubillo Marcos JM. Training of inspiratory muscles in chronic obstructive lung disease. Its impact on functional changes and exercise tolerance. *Archivos de Bronconeumologia* 1998;**34**(2):64-70.

Demir-Deriven 2001 *{published data only}*

* Demir-Deviren S, Carrieri-Kohlman V, Nguyen H, Neuhaus J, Eiser S, Stulbarg MS. Long term effect of exercise on dyspnea and exercise performance in COPD: how much training is enough?. *American Journal of Respiratory and Critical Care Medicine* 2001;**163**(Suppl 5):A13.

Demir-Deriven 2002 *{published data only}*

* Demir-Deviren S, Carrieri-Kohlman V, Nguyen H, Paul SM, Stulbarg MS. Effects of gender on dyspnea with activities of daily living and health-related quality of life after long term exercise training in patients with COPD. *American Journal of Respiratory and Critical Care Medicine* 2002;**165**(Suppl 8):A734.

Dewse 1998 *{published data only}*

Dewse M. Improving pulmonary disease outcomes. *Nursing New Zealand* 1998;**4**(9):20-2.

Di Marzo 2000 *{published data only}*

Di Marzo A, Torrice M, Ciappi G. Inspiratory muscle training and relaxation therapy in advanced COPD patients. *European Respiratory Journal* 2000;**16**(Suppl 31):46S.

Di Marzo A, Torrice M, Ciappi G. Inspiratory muscles training and relaxation in COPD patients. *American Journal of Respiratory and Critical Care Medicine* 2000;**161**(Suppl 3):A752.

Downes Vogel 2002 *{published data only}*

Downes Vogel PJ. Effect of adding inspiratory muscle training to a pulmonary rehabilitation program for patients with COPD which includes upper extremity exercises. *American Journal of Respiratory and Critical Care Medicine* 2002;**165**(Suppl 8):A737.

Dushianthan 2009 *{published data only}*

Dushianthan A. Safety and effectiveness of home-based pulmonary rehabilitation in COPD. *Thorax* 2009;**64**(7):619.

Egan 2012 *{published and unpublished data}*

Egan C, Costello R, Deering B, McCormack N, Blake C. Short term and long term effects of pulmonary rehabilitation on physical activity in COPD. *Respiratory Medicine* 2012;**106**:1671-9.

Ellum 2002 *{published data only}*

Ellum SG, Rafferty GF, Nikoletou D, Moxham J. Effect of forward lean sitting on work of breathing and breathless scores in stable, severe COPD patients following exercise induced breathlessness. *American Journal of Respiratory and Critical Care Medicine* 2002;**165**(Suppl 8):A267.

Emtner 1998 *{published data only}*

Emtner M, Finne M, Stalenheim G. High-intensity physical training in adults with asthma. A comparison between training

on land and in water. *Scandinavian Journal of Rehabilitation Medicine* 1998;**30**(4):201-9.

Epstein 1997 *{published data only}*

Epstein SK, Celli BR, Martinez FJ, Couser JI, Roa J, Pollock M, et al. Arm training reduces the VO2 and VE cost of unsupported arm exercise and elevation in chronic obstructive pulmonary disease. *Journal of Cardiopulmonary Rehabilitation* 1997;**17**(3):171-7.

Esteve 1996 *{published data only}*

Esteve F, Blanc-Gras N, Gallego J, Benchetrit G. The effects of breathing pattern training on ventilatory function in patients with COPD. *Biofeedback and Self Regulation* 1996;**21**(4):311-21.

Fan 2008 *{published data only}*

Fan VS, Giardino ND, Blough DK, Kaplan RM, Ramsey SD, Fishman AP, et al. Costs of pulmonary rehabilitation and predictors of adherence in the National Emphysema Treatment Trial. *COPD* 2008;**5**(2):105-16.

Fan VS, Ramsey SD, Blough DK. Costs of pulmonary rehabilitation and predictors of adherence [Abstract]. Poster #608. American Thoracic Society International Conference; 2007 May 18-23; San Francisco. 2007; Vol. Poster #608.

Foglio 2001 *{published data only}*

* Foglio K, Bianchi L, Ambrosino N. Is it really useful to repeat outpatient pulmonary rehabilitation programs in patients with chronic airway obstruction? A 2-year controlled study. *Chest* 2001;**119**(6):1696-704.

Gadoury 2005 *{published data only}*

Gadoury MA, Schwartzman K, Rouleau M, Maltais F, Julien M, Beaupre A, et al. Self-management reduces both short- and long-term hospitalisation in COPD. *European Respiratory Journal* 2005;**26**(5):853-7.

Gale 2009 *{published data only}*

Gale NS, Duckers JM, Proud D, Lines T, Enright S, Cockcroft JR, et al. Pulmonary rehabilitation improves cardiovascular risk factors in patients with COPD. *Thorax* 2009;**64**(Suppl IV):A40 [S75].

Garuti 2010 *{published data only}*

Garuti G. Home rehabilitation and therapy. *Rassegna di Patologia dell'Apparato Respiratorio* 2010;**25**(2):76-7.

Gautier 1998 *{unpublished data only}*

* Gautier V, Godard P, Serres I, Hayot M, Prefaut C. Respiratory rehabilitation in chronic obstructive pulmonary disease (COPD) outpatients under long term oxygen therapy. *American Journal of Respiratory and Critical Care Medicine* 1998;**157**(Suppl 3):A119.

Gautier 2002 *{unpublished data only}*

* Gautier V, Pison C, Fournial F, Benichou M, Tardif C, Veale D, et al. Home rehabilitation in COPD patients on long term oxygen therapy (LTOT): a multi-centre randomized controlled study [abstract]. European Respiratory Society Annual Congress; 2002; September 14-18; Stockholm. 2002:Abstract nr: P1520.

Ghanem 2010 *{published data only}*

Ghanem ME, Laal EA, Mehany M, Tolba K. Home-based pulmonary rehabilitation program: Effect on exercise tolerance and quality of life in chronic obstructive pulmonary disease patients. *Annals of Thoracic Medicine* 2010;**5**(1):18-25.

Gimenez 2000 *{published data only}*

Gimenez M, Servera E, Vergara P, Bach JR, Polu JM. Endurance training in patients with chronic obstructive pulmonary disease: A comparison of high versus moderate intensity. *Archives of Physical Medicine and Rehabilitation* 2000;**81**(1):102-9.

Girodo 1992 *{published data only}*

Girodo M, Ekstrand KA, Metivier GJ. Deep diaphragmatic breathing: rehabilitation exercises for the asthmatic patient. *Archives of Physical Medicine and Rehabilitation* 1992;**73**(8):717-20.

Goldman 1997 *{unpublished data only}*

Goldman J, Carr V, Dobson L, Jones S, Rowles R, Wallace L. A randomised controlled trial of pulmonary rehabilitation (PR) in a district general hospital. *Thorax* 1997;**52**(Suppl 6):A10.

Goldman J, Carr V, Dobson L, Jones S, Rowles R, Wallace L. Does pulmonary rehabilitation produce a lasting benefit in patients with COPD?. *Thorax* 1997;**52**(Suppl 6):A10.

Gormley 1993 *{published data only}*

Gormley JM, Carrieri-Kohlman V, Douglas MK, Stulbarg MS. Treadmill self-efficacy and walking performance in patients with COPD. *Journal of Cardiopulmonary Rehabilitation* 1993;**13**(6):424-31.

Gosselink 1990 *{unpublished data only}*

* Gosselink H, van Keimpema A, Wagenaar R, Chadwick Straver R. The relative efficacy of a rehabilitation-programme in COPD patients. *European Respiratory Journal* 1990;**10**(Suppl 3):212S.

Green 1999 *{published data only}*

Green RH, Singh SJ, Williams J, Morgan MDL. A randomised controlled trial of four weeks v seven weeks pulmonary rehabilitation in chronic obstructive pulmonary disease (COPD). *Thorax* 1999;**54**(Suppl 3):S63.

* Green RH, Singh SJ, Williams J, Morgan MDL. A randomised controlled trial of four weeks versus seven weeks of pulmonary rehabilitation in chronic obstructive pulmonary disease. *Thorax* 2001;**56**(2):143-5.

Griffiths 1996 *{unpublished data only}*

* Griffiths TL, Gregory SE, Ward SA, Saunders KB, Whipp BJ. Effects of structured domicilliary exercise training programme on quality of life and walking tolerance in patients with severe COPD. *European Respiratory Journal* 1996;**9**(Suppl 23):145S.

Grosbois 1999 *{published data only}*

Grosbois JM, Lamblin C, Lemaire B, Chekroud H, Dernis JM, Douay B, et al. Long-term benefits of exercise maintenance after outpatient rehabilitation program in patients with chronic

obstructive pulmonary disease. *Journal of Cardiopulmonary Rehabilitation* 1999;**19**(4):216-25.

Gu 2011 *{published data only}*

Gu W, Chen R, Xi Y. The effect of pulmonary rehabilitation toward expiratory airflow limitation in patients with chronic obstructive pulmonary disease. *European Respiratory Society 21st Annual Congress; 2011 Sep 24-28; Amsterdam* 2011;**38**(55):657s [p3654].

Guell 2006 *{published data only}*

Guell R, de Lucas P, Galdiz JB, Montemayor T, Rodriguez Gonzalez-Moro JM, Gorostiza A, et al. Home vs hospital-based pulmonary rehabilitation for patients with chronic obstructive pulmonary disease: a Spanish multicenter trial. *Archivos de Bronconeumologia* 2008;**44**:512-18.

Harver 1989 *{published data only}*

Harver A, Mahler DA, Daubenspeck JA. Targeted inspiratory muscle training improves respiratory muscle function and reduces dyspnea in patients with chronic obstructive pulmonary disease. *Annals of Internal Medicine* 1989;**111**(2):117-24.

Hawkins 1999 *{published data only}*

Hawkins P, Nikoletou D, Johnson LC, Moxham J. Increased exercise capacity in patients with severe COPD after cycle training with proportional assist ventilation (PAV). *Thorax* 1999;**54**(Suppl 3):A61 (P169).

Hawkins P, Nikoletou D, Johnson LC, Moxham J. Physiological training in severe chronic obstructive pulmonary disease (COPD) is possible using proportional assist ventilation (PAV). *Thorax* 1999;**54**(Suppl 3):A61 (P170).

Hentschel 2002 *{published data only}*

* Hentschel M, Becker J, Lepthin HJ. Effects of a high intensity training program on patients with chronic obstructive airways disease (COAD) [Nutzen eines intensiven trainingsprogrammes bei patienten mit obstruktiver atemwegskrankheit]. *Pneumologie* 2002;**56**(4):240-6.

Holland 2003 *{published data only}*

* Holland A, Nehez E, Ntoumenopoulos. Unsupported upper limb exercise training in chronic obstructive pulmonary disease - effect on endurance, symptoms and quality of life [Abstract]. Proceedings of the Thoracic Society of Australia & New Zealand, Annual Scientific Meeting; 2003 4-9 April; Adelaide. 2003:P094.

Hospes 2009 *{published data only}*

Hospes G, Bossenbroek L, Ten Hacken NH, van Hengel P, de Greef MH. Enhancement of daily physical activity increases physical fitness of outclinic COPD patients: results of an exercise counselling program. *Patient Education and Counseling* 2009;**75**(2):274-8.

Houchen 2011 *{published data only}*

Houchen L, Menon M, Harrison S, Sandland C, Morgan M, Singh S, et al. Does protein supplementation enhance the effects of resistance training in patients with COPD?. *European Respiratory Society 21st Annual Congress; 2011 Sep 24-28; Amsterdam* 2011;**38**(55):325s [1888].

Innocenti 2000 *{published data only}*

Innocenti F, Fabbri A, Guerrini M, Fonseca D, Lippi P. Results of an outpatient pulmonary rehabilitation program in patients with COPD. *European Respiratory Journal* 2000;**16**(Suppl 31):46S.

Jensen 1983 *{published data only}*

* Jensen PS. Risk, protective factors, and supportive interventions in chronic airway obstruction. *Archives of General Psychiatry* 1983;**40**(11):1203-7.

Johnson 2000 *{published data only}*

* Johnson LC, Hawkins P, Polkey MI, Moxham J. The effects of pulmonary rehabilitation on inspiratory muscle loading in severe COPD. *Thorax* 2000;**55**(Suppl 3):A52.

Jungblut 2007 *{published data only}*

Jungblut S, Frickmann H, Klingler J, Muller U, Bargon J. Improvement in expiratory peak flow (PEF) of COPD patients due to "lung" sport for 12 months [Verbesserung des exspiratorischen Spitzenflusses (PEF) von COPD-Patienten durch Lungensport über 12 Monate]. *Pneumologie* 2007;**61**(2):83-5.

Kaplan 1990 *{published data only}*

* Kaplan RM. Randomized trial of rehabilitation in chronic obstructive pulmonary disease. *Journal of Rehabilitation Research and Development* 1991;**28**(1):268.

Katsura 2000 *{published data only}*

Katsura H, Yamada K, Motegi T, Kida K. Effectiveness of a short-course inpatient comprehensive pulmonary rehabilitation program managed by the critical path for COPD in the elderly. *American Journal of Respiratory and Critical Care Medicine* 2000;**161**(Suppl 3):A495.

Kurabayashi 1998 *{published data only}*

Kurabayashi H, Machida I, Handa H, Akiba T, Kubota K. Comparison of three protocols for breathing exercises during immersion in 38 degrees C water for chronic obstructive pulmonary disease. *American Journal of Physical Medicine and Rehabilitation* 1998;**77**(2):145-8.

Kurabayashi 2000 *{published data only}*

Kurabayashi H, Machida I, Tamura K, Iwai F, Tamura J, Kubota K. Breathing out into water during subtotal immersion: a therapy for chronic pulmonary emphysema. *American Journal of Physical Medicine and Rehabilitation* 2000;**79**(2):150-3.

Larson 1999 *{published data only}*

Larson JL, Covey MK, Wirtz SE, Berry JK, Alex CG, Langbein WE, et al. Cycle ergometer and inspiratory muscle training in chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine* 1999;**160**(2):500-7.

Lathlean 2008 *{published and unpublished data}*

Lathlean T, Cafarella P, Rowett D, Frith P, Lawrence J. Combining chronic condition self management and pulmonary

rehabilitation for COPD patients. *Respirology* 2008;**13**(Suppl 5):A172 [P2-114].

Laukandt 1998 *{published data only}*

Laukandt I, Kaspar P, Petro W. Patiententraining in der pneumologischen rehabiltation verbessert die lebensqulität bei patienten mit chronisch obstruktiven atemwegserkrankungen [Patient training in pneumological rehabilitation improves quality of life in patients with chronic obstructive pulmonary disease]. *Pneumologie* 1998;**52**(SH1):41S.

Levine 1986 *{published data only}*

Levine S, Weiser P, Gillen J. Evaluation of a ventilatory muscle endurance training program in the rehabilitation of patients with chronic obstructive pulmonary disease. *American Review of Respiratory Disease* 1986;**133**(3):400-6.

Lewczuk 1998 *{published data only}*

* Lewczuk J, Piszko P, Kowalska-Superlak M, Jagas J, Wojciak S, Wrabec K. Impact of 2-year rehabilitation on exercise tolerance and transcutaneous oxygen saturation during exercise in patients with chronic obstructive pulmonary disease. *Polskie Archiwum Medycyny Wewn¿trznej* 1998;**100**:331-6.

Piszko P, Lewczuk J, Kowalska Superlak M, Wrabec K. Oxygen saturation at rest, on exercise and during sleep in patients with COPD undergoing pulmonary rehabilitation program. Two years, prospective, controlled study [Kontrolowane badanie przezskorne wysycenia tlenem krwi tetniczej w czasie dnia, w nocy oraz w czasie wysiiku u rehabilitowanych chorych na pochp]. *Pneumonologia i Alergologia Polska* 2002;**70**:11-2.

Li 2002 *{published data only}*

Li YL. Nutritional supplementation and respiratory gym in patients with chronic obstructive pulmonary disease. *Zhongguo Linchuang Kangfu (Chinese Journal of Clinical Rehabilitation)* 2002;**6**(9):1260-2.

Liu 2002 *{published data only}*

Liu YF. Effects of the comprehensive pulmonary rehabilitation programme on the quality of life of the patients with COPD in recovery period. *Zhongguo Linchuang Kangfu (Chinese Journal of Clinical Rehabilitation)* 2002;**6**(21):3170-1.

Lotshaw 2003 *{published data only}*

Lotshaw A, Duncan C, Hart M, Millard M. Land and water-based pulmonary rehabilitation; a comparison of physical performance and quality of life in patients with COPD [Abstract]. National COPD Conference; 2003 November 14-15; Arlington. 2003:Abstract no: 1143.

Ma 2002 *{published data only}*

Ma HM, Chan WC, Chung PH, Tung SY, Dai LK, Sung JY. A randomised control study of 3-week versus 4-week pulmonary rehabilitation program (PRP) for moderate to severe geriatric COPDs in Hong Kong. Chest Meeting; 2002 2-7 November 2002; San Diego. 2002:P195.

Mador 2002 *{published data only}*

Mador MJ, Bozkanat E, Aggarwal A, Shaffer M, Kufel TJ. Does strength training alter quadriceps fatigability in patients with COPD. *American Journal of Respiratory and Critical Care Medicine* 2002;**165**(Suppl 8):A506.

Mador 2004 *{published data only}*

* Mador MJ, Bozkanat E, Aggarwal A, Shaffer M, Kufel TJ. Endurance and strength training in patients with COPD. *Chest* 2004;**125**(6):2036-45.

Mador MJ, Deniz O, Aggarwal A, Shaffer M, Kufel TJ, Spender CM. Effect of respiratory muscle endurance training in patients with COPD undergoing pulmonary rehabilitation. *Chest* 2005;**128**(3):1216-24.

Mador MJ, Deniz O, Aggarwal A, Shaffer M, Kufel TJ, Spengler CM. Effect of respiratory muscle endurance training in patients with COPD undergoing pulmonary rehabilitation [Abstract]. American Thoracic Society 99th International Conference; 2003 May 16-21; Seattle. 2003:B046, Poster D8.

Make 2000 *{published data only}*

Make B, Tolliver R, Christensen P, Karla S, MacIntyre N, Ries A. Pulmonary rehabilitation improves exercise capacity and dyspnea in the national emphysema treatment trial (NETT). *American Journal of Respiratory and Critical Care Medicine* 2000;**161**(Suppl 3):A254.

Martinez 1993 *{published data only}*

Martinez FJ, Vogel PD, Dupont DN, Stanopoulos I, Gray A, Beamis JF. Supported arm exercise vs unsupported arm exercise in the rehabilitation of patients with severe chronic airflow obstruction. *Chest* 1993;**103**(5):1397-402.

McKeogh 2012 *{published data only}*

McKeough ZJ, Bye PTP, Alison JA. Arm exercise training in chronic obstructive pulmonary disease: a randomised controlled trial. *Chronic Respiratory Disease* 2012;**9**(3):153–62.

Morgan 1999 *{published data only}*

Morgan MDL. The prediction of benefit from pulmonary rehabilitation: setting, training intensity and the effect of selection by disability. *Thorax* 1999;**54**(Suppl 2):S3-S7.

Moros Garcia 1996 *{published data only}*

* Moros Garcia JSM, Cisneros Lanuza MT, Rubio Obanos MT, Samperiz Legarre AL, Escolar Castellon F, Moros Garcia MT. Rehabilitation of disability in COPD [Rehabilitacion de la discapacidad en la enfermedad pulmonar obstructiva cronica]. *Rehabilitacion* 1996;**30**:194-200.

Morris 2003 *{published data only}*

Morris N, Sabapathy S, Kingsley R, Schneider D, Adams L. Improved exercise tolerance with intermittent exercise in patients with moderate COPD [Abstract]. American Thoracic Society 99th International Conference; 2003 May 16-21; Seattle. 2003:C042, Poster C34.

MTU 2003 *{published data only}*

Medical Technology Unit-Federal Social Insurance Office Switzerland. Effectiveness of Rehabilitation in Chronic Obstructive Pulmonary Disease. Bern, Switzerland: Swiss Federal Office of Public Health, 2003.

Murphy 2004 *{published data only}*

Murphy M, Campbell M, Saunders J, Jackson B, Rangan N, Zimmerman F, et al. A randomised, controlled trial of pulmonary rehabilitation, weekly exercise and better health self-management in COPD [Abstract]. *Respirology* 2004;**9**(Suppl 2):A48.

Murphy MC, Berlowitz DJ, Saunders JE, Campbell M, Jackson B. A randomised trial to compare pulmonary rehabilitation (PRP) & the Stanford model chronic disease self management program (CDSMP) in COPD with 12 month follow-up. *Respirology* 2005;**10**(Suppl):A61.

Myers 2000 *{published data only}*

Myers R, Ries AL, Kaplan RM, Prewitt LM. Pulmonary rehabilitation: outcome measures and maintenance. *American Journal of Respiratory and Critical Care Medicine* 2000;**161**(Suppl 3):A254.

Na 2005 *{published data only}*

Na JO, Kim DS, Yoon SH, Jegal YJ, Kim WS, Kim ES, et al. A simple and easy home-based pulmonary rehabilitation programme for patients with chronic lung diseases. *Monaldi Archives for Chest Disease* 2005;**63**(1):30-6.

Nasilowski 2011 *{published and unpublished data}*

Nasilowski J, Przybylowski T, Zielinski J, Chazan R, Sliwinski P, Bielen P, et al. Stationary bicycle training at home in COPD patient on LTOT. Is it enough to improve quality of life and exercise capacity? A pilot study. *European Respiratory Society 21st Annual Congress; 2011 Sep 24-28; Amsterdam* 2011;**38**(55):881s [P4813].

Nava 1998 *{published data only}*

Nava S. Rehabilitation of patients admitted to a respiratory intensive care unit. *Archives of Physical Medicine and Rehabilitation* 1998;**79**(7):849-54.

Ndundu 2001 *{published data only}*

* Muzembo Ndundu J, Nkakudulu Bikuku H, Frans A. Respiratory rehabilitation in patients with bronchial asthma and chronic obstructive pulmonary disease (COPD) in Kinshasa. *Revue de Pneumologie Clinique* 2001;**57**(3):209-18.

Neder 2002 *{published data only}*

Neder JA, Sword D, Cochrane LK, Mackay E, Ward SA, Clark CJ. A new rehabilitative strategy for severely-disabled patients with advanced COPD: neuromuscular electrical stimulation. *American Journal of Respiratory and Critical Care Medicine* 2001;**163**(Suppl 5):A967.

* Neder JA, Sword D, Ward SA, Mackay E, Cochrane LM, Clark CJ. Home based neuromuscular electrical stimulation as a new rehabilitative strategy for severely disabled patients with chronic obstructive pulmonary disease (COPD). *Thorax* 2002;**57**(4):333-7.

Newall 2000 *{published data only}*

Newall C, Richardson B, McConnell AK, Stockley RA, Hill SL. Inspiratory muscle training (IMT) as an adjunct to a pulmonary rehabilitation programme in COPD. *American Journal of Respiratory and Critical Care Medicine* 2000;**161**(Suppl 3):A753.

Nguyen 2005 *{published data only}*

Nguyen HQ, Carrieri-Kohlman V. Dyspnea self-management in patients with chronic obstructive pulmonary disease: moderating effects of depressed mood. *Psychosomatics* 2005;**46**(5):402-10.

Ninot 2011 *{published data only}*

Ninot G, Moullec G, Picot MC, Jaussent A, Hayot M, Desplan M, et al. Cost-saving effect of supervised exercise associated to COPD self-management education program. *Respiratory Medicine* 2011;**105**(3):377-85.

Nosworthy 1992 *{published data only}*

Nosworthy J, Barter C, Thomas S, Flynn M. An evaluation of three elements of pulmonary rehabilitation. *The Australian Journal of Physiotherapy* 1992;**38**(3):189-93.

Nygren-Bonnier 2002 *{published data only}*

Nygren-Bonnier M, Karlsson S, Klefbeck B. Effects of a home-based training program and an outpatient hospital-based training program on patients with chronic obstructive pulmonary disease (COPD) [Abstract]. European Respiratory Society 12th Annual Congress; 2002 Sep 14-18; Stockholm. 2002:abstract nr: P1166.

O'Hara 1987 *{published data only}*

O'Hara WJ, Lasachuk KE, Matheson PC, Renahan MC, Schlotter DG, Lilker ES. Weight training benefits in chronic obstructive pulmonary disease: a controlled crossover study. *Respiratory Care* 1987;**32**(8):660-8.

Ortega 2002 *{published data only}*

Cejudo P, Ortega F, Villagomez R, Hernandez A, Toral J, Sanchez H, et al. Effects of peripheral muscle training on dyspnea and leg pain in patients with chronic obstructive pulmonary disease. *European Respiratory Journal* 2001;**18**(Suppl 33):188S.

* Ortega F, Toral J, Cejudo P, Villagomez R, Sanchez H, Castillo J, et al. Comparison of effects of strength and endurance training in patients with chronic obstructive pulmonary disease. *American Journal or Respiratory and Critical Care Medicine* 2002;**166**(5):669-74.

Toral Marìn J, Ortega F, Cejudo P, Elìas T, Sanchez H, Montemayor T. Effects of an exercise training programme on the quality of life of patients with COPD [Repercusiones en la calidad de vida de un programa de entrenamiento con ejercio en pacientes con EPOC]. *Archivos de Bronconeumologìa* 1998;**34**(Suppl 1):64.

Toral Marìn J, Ortega F, Cejudo P, Elìas T, Sanchez H, Montemayor T. Physiological effects of an exercise training programme in patients with stable COPD [Repercusion fisiolgica de un programa de entrenamento con ejercio en pacientes con EPOC estable]. *Archivos de Bronconeumologìa* 1998;**34**(Suppl 1):33.

Patessio 1994 *{published data only}*

Patessio A, Donner CF. Selection criteria for exercise training in patients with COPD. *Z-Kardiol* 1994;**83**(Suppl 3):155-8.

Petersen 2008 *{published data only}*

Petersen AM, Mittendorfer B, Magkos F, Iversen M, Pedersen BK. Physical activity counteracts increased whole-body protein breakdown in chronic obstructive pulmonary disease patients. *Scandinavian Journal of Medicine and Science in Sports.* 2008;**18**(5):557-64.

Piantadosi 2000 *{published data only}*

Piantadosi S. A prospective randomized trial of lung volume reduction surgery. *Journal of Cardiopulmonary Rehabilitation* 2000;**20**(1):24-36.

Pison 2001 *{published data only}*

Pison C. Exercise retraining in severe chronic obstructive bronchopneumopathy [Le Réentraînement a l'effort en pratique]. *Revue Des Maladies Respiratoires* 2001;**18**(2):S35-6.

Pison 2008 *{published data only}*

Pison CM, Cano NJ, Cherion C, Caron F, Antonini MT, Gonzalez-Bermejo J, et al. Multimodal nutritional rehabilitation improves clinical outcomes of malnourished patients with chronic respiratory failure: a randomised controlled trial. *Thorax* 2011;**66**(11):953-60.

Pitta 2004 *{unpublished data only}*

* Pitta F, Brunetto AF, Padovani CR, Godoy I. Effects of isolated cycle ergometer training on patients with moderate-to-severe chronic obstructive pulmonary disease. *Respiration* 2004;**71**(5):477-83.

de Oliveira Pitta F, Brunetto AF, Probst VS, Padovani CR, de Godoy I. Effects of isolated lower extremity training with cycle-ergometer in moderate/severe COPD patients [Abstract]. *European Respiratory Journal* 2002;**20**(Suppl 38):18S.

Ponsioen 2010 *{published data only}*

Ponsioen B. Temporary effect of physiotherapy for moderately severe COPD. *Nederlands Tijdschrift voor Geneeskunde* 2010;**154**(21):1021.

Prince 1989 *{published data only}*

Prince KL, Helm M. Effectiveness of a rehabilitation programme in chronic bronchitis and emphysema. *Clinical Rehabilitation* 1989;**3**:211-4.

Probst 2003 *{published data only}*

Probst VS, Heyvaert H, Coosemans I, Pitta F, Spruit MA, Troosters T, et al. Effects of a rollator on exercise capacity, gas exchange and ventilation in COPD patients [Abstract]. American Thoracic Society 99thInternational Conference; 2003 May 16-21; Seattle. 2003:C042, Poster C36.

* Probst VS, Troosters T, Coosemans I, Spruit MA, Pitta FDO, Decramer M, et al. Mechanisms of improvement in exercise capacity using a rollator in patients with COPD. *Chest* 2004;**126**(4):1102-7.

Proshchaev 2009 *{published data only}*

Proshchaev KI, Il'nitskii AN, Medvedev DS, Altukhov AA, Aksenov DV, Sovenko GN, et al. The role of the short-wave therapy in rehabilitation of elderly patents with chronic obstructive pulmonary disease. *Uspekhi Gerontologii / Rossiiskaia Akademiia Nauk, Gerontologicheskoe Obshchestvo (Advances in Gerontology)* 2009;**22**(2):368-71.

Puente 1996 *{published data only}*

Puente Maestu L, Sanz ML, Sanz P, Mayol P, de Lucas P, Cubillo JM. Training effects of a partly supervised exercise program in COPD patients. *European Respiratory Journal* 1996;**9**(Suppl 23):380S.

Raschke 1990 *{published data only}*

Raschke F, Schlenker E, Fischer J. Development of nocturnal oxygen desaturation, sleep disorders, and pulmonary function during rehabilitation in chronic obstructive bronchitis. *European Respiratory Journal* 1990;**3**(Suppl 10):326S.

Regiane Resqueti 2007 *{published data only}*

Regiane Resqueti V, Gorostiza A, Galdiz JB, Lopez de Santa Maria E, Casan Clara P, Guell Rous R. Benefits of a home-based pulmonary rehabilitation program for patients with severe chronic obstructive pulmonary disease. *Archivos de Bronconeumologia* 2007;**43**(11):599-604.

Reilly 2000 *{published data only}*

* Reilly J, Moy M, Kaplan R, Diaz P, Benditt J, Criner G, et al. Predictors of improved health-related quality of life (QOL) following pulmonary rehabilitation in the national emphysema treatment trial (NETT). *American Journal of Respiratory and Critical Care Medicine* 2000;**161**(Suppl 3):A503.

Riario-Sforza 2009 *{published data only}*

Riario-Sforza G, Gincorvaia C, Paterniti F, Pessina L, Caligiuri R, Pravettoni C, et al. Effects of pulmonary rehabilitation on exercise capacity in patients with COPD: a number needed to treat study. *International Journal of COPD* 2009;**4**:315-9.

Ries 1986 *{published data only}*

Ries AL, Moser KM. Comparison of isocapnic hyperventilation and walking exercise training at home in pulmonary rehabilitation. *Chest* 1986;**90**(2):285-9.

Ries 1988 *{published data only}*

Ries AL, Ellis B, Hawkins RW. Upper extremity exercise training in chronic obstructive pulmonary disease. *Chest* 1988;**93**(4):688-92.

Ries 1995 *{published data only}*

Ries AL, Kaplan RM, Limberg TM, Prewitt LM. Effects of pulmonary rehabilitation on physiologic and psychological outcomes in patients with chronic obstructive pulmonary disease. *Annals of Internal Medicine* 1995;**122**:823-32.

Roberts 1999 *{published data only}*

* Roberts E, Wallace L, Rowles R, Jones S, Dobson L, Goldman JM. Do the effects of pulmonary rehabilitation (PR) last for 1 year in patients with COPD?. *Thorax* 1999;**54**(Suppl 3):64S.

Rooyackers 1996 *{published data only}*

Rooyackers JM, Dekhuijzen PN, Van Herwaarden CL, Folgering HT. Long-term effects of training in patients with COPD and exercise hypoxaemia. *European Respiratory Journal* 1996;**9**(Suppl 23):145S.

Rudkin 1997 *{published data only}*

Rudkin ST, Harrison S, Harvey I, White RJ. A randomised trial of hospital v home rehabilitation in severe chronic obstructive pulmonary disease (COPD). *Thorax* 1997;**52**(Suppl 6):41S.

Santiworakul 2009 *{published data only}*

Santiworakul A, Jarungjitaree S, Jalayondeja W, Chantarothorn S, Supaibulpipat S. Effect of lower extremity exercise on muscle strength and physical capacity in COPD patients. *Journal of the Medical Association of Thailand* 2009;**92**(4):556-63.

Sassi-Dambron 1995 *{published data only}*

Sassi-Dambron DE, Eakin EG, Ries AL, Kaplan RM. Treatment of dyspnea in COPD. A controlled clinical trial of dyspnea management strategies. *Chest* 1995;**107**(3):724-9.

Saunders 1965 *{published data only}*

Saunders KB, White JE. Controlled trial of breathing exercises. *British Medical Journal* 1965;**5463**:680-2.

Scherer 1998 *{published data only}*

Scherer YK, Schmieder LE, Shimmel S. The effects of education alone and in combination with pulmonary rehabilitation on self-efficacy in patients with COPD. *Rehabilitation Nursing* 1998;**23**(2):71-7.

Scorsone 2010 *{published data only}*

Scorsone D, Bartolini S, Saporiti R, Braido F, Baroffio M, Pellegrino R, et al. Does a low-density gas mixture or oxygen supplementation improve exercise training in COPD?. *Chest* 2010;**138**(5):1133-9.

Semenyuk 2007 *{published data only}*

Semenyuk S, Belevskiy A. Influence of the education program for COPD patients on a health related quality of life. *Chest* 2007;**132**(4):534s.

Serres 1997 *{published data only}*

* Serres I, Varray A, Vallet G, Micallef JP, Prefaut C. Improved skeletal muscle performance after individualized exercise training in patients with chronic obstructive pulmonary disease. *Journal of Cardiopulmonary Rehabilitation* 1997;**17**(4):232-8.

Sewell 2005 *{published data only}*

Sewell L, Singh SJ, Williams JE, Collier RJ, Morgan MDL. Goal directed pulmonary rehabilitation does not significantly improve health status and domestic function. *European Respiratory Journal* 2001;**18**(Suppl 33):187S.

* Sewell L, Singh SJ, Williams JEA, Collier R, Morgan MDL. Can individualized rehabilitation improve functional independence in elderly patients with COPD?. *Chest* 2005;**128**(3):1194-200.

Sinclair 1980 *{published data only}*

Sinclai DJ, Ingram CG. Controlled trial of supervised exercise training in chronic bronchitis. *British Medical Journal* 1980;**280**(6213):519-21.

Sindhwani 2011 *{published data only}*

Sindhwani G, Verma A, Biswas D, Srivastava M, Rawat J. A pilot study on domiciliary pulmonary rehabilitation programme in the management of severe chronic obstructive pulmonary disease. *Singapore Medical Journal* 2011;**52**(9):689-93.

Sivori 1998 *{published data only}*

* Sivori M, Rhodius E, Kaplan P, Talarico M, Gorojod G, Carreras B, et al. Exercise training in chronic obstructive pulmonary disease. *Medicina* 1998;**58**:717-27.

Solanes Garcia 2004 *{published and unpublished data}*

Solanes Garcia I. Evaluate the effects of pulmonary rehabilitation on chronic obstructive pulmonary disease [PhD thesis]. Universitat Autonoma de Barcelona, 2004.

Sparrow 1997 *{published data only}*

Sparrow D, Gottlieb D, Lieberman S, Garshick E, Schwartzstein R, Celli B. Randomized controlled trial of upper-extremity exercise training in patients with COPD. *Rehabiliation Rearch and Development Progress Reports* 1997;**July**:106-7.

Spruit 2001 *{published data only}*

Spruit MA, Gosselink R, Troosters T, De Paepe K, Decramer M. Exercise training in patients with COPD and muscle weakness. *American Journal of Respiratory and Critical Care Medicine* 2001;**163**(Suppl 5):A967.

Spruit MA, Gosselink R, Troosters T, Decramer M. Rehabilitation of patients with moderate to severe COPD and muscle weakness. *European Respiratory Journal* 2001;**18**(Suppl 33):23S.

Steele 2008 *{published data only}*

Steele BG, Belza B, Cain KC, Coppersmith J, Lakshminarayan S, Howard J, et al. A randomized clinical trial of an activity and exercise adherence intervention in chronic pulmonary disease. *Archives of Physical Medicine and Rehabilitation* 2008;**89**(3):404-12.

Stellefson 2009 *{published data only}*

Stellefson ML. Efficacy of DVD technology in chronic obstructive pulmonary disease self-management education of rural patients. *Dissertation Abstracts International Section A: Humanities and Social Sciences* 2009;**70**(2-A):488.

Sudo 1997 *{published data only}*

* Sudo E, Ohga E, Matsuse T, Teramoto S, Nagase T, Katayama H, et al. The effects of pulmonary rehabilitation combined with inspiratory muscle training on pulmonary function and inspiratory muscle strength in elderly patients with chronic obstructive pulmonary disease. *Japanese Journal of Geriatrics* 1997;**34**:929-34.

Sugawara 2007 *{published data only}*

* Sugawara K, Takashi H, Kasai C, Kiyokawa N, Watanabe T, Fujii S, et al. Comprehensive pulmonary rehabilitation improves

systemic inflation in patients with stable COPD. *European Respiratory Journal* 2007;**30**(Suppl 51):514s [E3082].

Sun 2003 *{published data only}*

* Sun JX, Yin MX, Shao H, Li ZS, Li S W. Effect of respiratory muscle gymnastics on lung function and quality of life in the old patients with chronic obstructive pulmonary disease. *Zhonghua Linchuang Kangfu Zazhi* 2003;**7**(27):3698-9.

Swerts 1990 *{published data only}*

Swerts PM, Kretzers LM, Terpstra-Lindeman E, Verstappen FT, Wouters EF. Exercise reconditioning in the rehabilitation of patients with chronic obstructive pulmonary disease: a short- and long-term analysis. *Archives of Physical Medicine and Rehabilitation* 1990;**71**(8):570-3.

Taylor 2012 *{published data only}*

Taylor SJC, Sohanpal R, Bremner SA, Devine A, McDaid D, Fernandez JL, et al. Self-management support for moderate-to-severe chronic obstructive pulmonary disease: a pilot randomised controlled trial. *British Journal of General Practice* 2012;**62**(603):e687-95.

Toevs 1984 *{published data only}*

Toevs CD, Kaplan RM, Atkins CJ. The costs and effects of behavioral programs in chronic obstructive pulmonary disease. *Medical Care* 1984;**22**(12):1088-100.

Troosters 1999 *{published data only}*

Troosters T, Gosselink R, Decramer M. Pulmonary rehabilitation in patients with severe chronic obstructive pulmonary disease. *Monaldi Archives for Chest Disease* 1999;**54**(6):510-3.

Tsang 2001 *{published data only}*

Tsang AH, Carrieri-Kohlman V, Janson S, Gold W, Stulbarg MS. Effectiveness of three strengths of education and exercise on self-efficacy for walking in patients with COPD. *American Journal of Respiratory and Critical Care Medicine* 2001;**163**(Suppl 5):A968.

Ubaidullayev 1990 *{published data only}*

Ubaidullayev AM. Rehabilitation of patients with chronic bronchitis. *European Respiratory Journal* 1990;**3**(Suppl 10):412S.

Vargas 1998 *{published data only}*

* Vargas R, Sanchez H, Des Castillo D, Cehudo P, Ortega F, Montemayor T. Repercusion del entrenamiento muscular ventilatorio sobre la disnea, ejercicio y calidad de vida en la EPOC. *Neumosur* 1998;**10**(1):18.

Vargas R, Sánchez H, Del Castillo D, Cejudo P, Ortega F, Montemayor T. Impact of ventilatory muscle training on dyspnea, exercise and quality of life in COPD. *Neumosur* 1998;**10**(1):17.

Vogiatzis 1999 *{published data only}*

Vogiatzis I, Sherman R, Williamson A, Miles J, Taylor I. Physiological effects of rehabilitative exercise training in patients with chronic obstructive pulmonary disease (COPD). *Journal of Sports Sciences* 1999;**17**:544-5.

Vogiatzis I, Williamson A, Miles J, Taylor I. Effects of a 12-week supervised outpatient rehabilitation programme on physical performance in patients with COPD in the north east of England. *Thorax* 1997;**52**(Suppl 6):P24.

* Vogiatzis I, Williamson AF, Miles J, Taylor IK. Physiological response to moderate exercise workloads in a pulmonary rehabilitation program in patients with varying degrees of airflow obstruction. *Chest* 1999;**116**:1200-7.

Williamson A, Vogiatzis I, Miles J, Taylor I. Effects of rehabilitation on exercise tolerance & quality of life in patients with chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine* 1998;**157**(Suppl 3):A117.

Vogiatzis 2001 *{published data only}*

* Vogiatzis I, Sideri D, Pentaraki M, Komboti M, Nanas S, Roussos C. Interval versus continuous rehabilitative exercise training at the same time maintained intensity in patients with COPD: a randomised trial of the effects on exercise tolerance and quality of life. *American Journal of Respiratory and Critical Care Medicine* 2001;**163**(5 Suppl):A968.

Vogiatzis 2002 *{published data only}*

* Vogiatzis I, Nanas S, Roussos C. Interval training as an alternative modality to continuous exercise in patients with COPD. *European Respiratory Journal* 2002;**20**:12-9.

Vogiatzis I, Nanas S, Sakelariou D, Kasiotis C, Papazahou O, Sideri D, et al. Interval training as an alternative rehabilitative modality to continuous exercise in patients with COPD: a randomised trial. *European Respiratory Journal* 2001;**18**(Suppl 33):187S.

Vogiatzis I, Sideri D, Pentaraki M, Komboti M, Nanas S, Roussos C. Interval versus continuous rehabilitative exercise training at the same maintained intensity in patients with COPD: a randomised trial of the effects on exercise tolerance and quality of life. *American Journal of Respiratory and Critical Care Medicine* 2001;**163**(Suppl 5):A968.

Vogiatzis I, Williamson AF, Miles J, Taylor IK. Long-term benefits of supervised maintenance rehabilitation strategies in patients with COPD: a 12-month randomised trial at an outpatient setting. *European Respiratory Journal* 2000;**16**(Suppl 31):159S.

Williamson A, Vogiatzis L, Miles J, Taylor I. Long term benefits of pulmonary rehabilitation on exercise tolerance in patients with chronic obstructive pulmonary disease (COPD). *European Respiratory Journal* 1998;**12**(Suppl 28):405S.

Wadell 2005 *{published data only}*

Wadell K. Physical training in patients with chronic obstructive pulmonary disease [Dissertation]. Umea University, 2004.

Wadell K, Henriksson-Larsen K, Lundgren R, Sundelin G. Group training in patients with COPD – Long-term effects after decreased training frequency. *Disability and Rehabilitation* 2005;**27**(10):571-81.

Wadell K, Lundgren R, Henriksson-Larsen K, Sundelin G. Training in water and on land in patients with COPD - short and

long term perspective [Abstract]. *European Respiratory Journal* 2004;**24**(Suppl 48):666s.

* Wadell K, Sundelin G, Henriksson-Larsén K, Lundgren R. High intensity physical group training in water - An effective training modality for patients with COPD. *Respiratory Medicine* 2004;**98**(5):428-38.

Wadell K, Sundelin G, Henriksson-Larsén K, Lundgren R. Physical training in water is effective in patients with COPD - A randomised controlled study. *European Respiratory Journal* 2002;**20**(Suppl 38):68s.

Wadell 2013 *{published data only}*

Wadell K, Webb KA, Preston M, Amornputtisathaporn N, Samis L, Patelli J, et al. Impact of pulmonary rehabilitation on the major dimensions of dyspnea in COPD. *Journal of Chronic Obstructive Pulmonary Disease* 2013;**10**:1-11.

Wanke 1994 *{published data only}*

Wanke T, Formanek D, Lahrmann H, Brath H, Wild M, Wagner C, et al. Effects of combined inspiratory muscle and cycle ergometer training on exercise performance in patients with COPD. *European Respiratory Journal* 1994;**7**(12):2205-11.

Wedzicha 1998 *{published data only}*

Bestall JC, Garrod R, Garnham R, Paul EA, Jones PW, Wedzicha JA. Long term effects of pulmonary rehabilitation in patients with COPD. *European Respiratory Journal* 1998;**12**(Suppl 28):2S.

Bestall JC, Garrod R, Garnham R, Paul EA, Jones PW, Wedzicha JA. Prolonged effects of pulmonary rehabilitation in patients with COPD. *Thorax* 1997;**52**(Suppl 6):40S.

Bestall JC, Garrod R, Garnham R, Paul EA, Jones PW, Wedzicha JA. Randomised controlled trial of pulmonary rehabilitation in house-bound patients with severe COPD. *European Respiratory Journal* 1997;**10**(Suppl 25):393S.

Garrod R, Bestall JC, Garnham R, Paul EA, Jones PW, Wedzicha JA. Randomised controlled trial of pulmonary rehabilitation in moderate and severe COPD: prolonged benefits. *American Journal of Respiratory and Critical Care Medicine* 1998;**157**(Suppl 3):A257.

* Wedzicha JA, Bestall JC, Garrod R, Garnham R, Paul EA, Jones PW. Randomised controlled trial of pulmonary rehabilitation in severe chronic obstructive pulmonary disease patients, stratified with the MRC dyspnoea scale. *European Respiratory Journal* 1998;**12**(2):363-9.

Weiner 1992a *{published data only}*

Weiner P, Azgad Y, Ganam R, Weiner M. Inspiratory muscle training in patients with bronchial asthma. *Chest* 1992;**102**(5):1357-61.

Wen 2004 *{published data only}*

Wen YL, Huang DF, Huang M, Huang YP. Evaluation on the effect of systemic exercise rehabilitation intervention in patients with chronic obstructive pulmonary disease. *Zhongguo Linchuang Kangfu* 2004;**8**(12):2224-5.

White 2002 *{published data only}*

* White RJ, Rudkin ST, Harrison ST, Day KL, Harvey IM. Pulmonary rehabilitation compared with brief advice given for severe chronic obstructive pulmonary disease. *Journal of Cardiopulmonary Rehabilitation* 2002;**22**(5):338-44.

Worth 1985 *{published data only}*

Störiko H, Worth H, Goeckenjan G, Smidt U. Effects of physical training on respiratory muscle endurance in patients with chronic airflow obstruction [Ermüdbarkeit der Atemmuskeln bei Patienten mit obstruktiven]. *Praxis und Klinik der Pneumologie* 1985;**39**(Suppl 1):877-8.

* Worth H, Storiko H, Goekenjan G, Smidt U. Effects of physical training on respiratory muscle endurance in patients with chronic airflow limitation [Zur Trainierbarkeit der Atemmuskeln bei Patienten mit obstruktiven Atemwegserkrankungen]. *Praxis und Klinik der Pneumologie* 1985;**39**(7):226-32.

Xu 2010 *{published data only}*

Xu YH, Wang JH, Li HF, Zhu XH, Wang G. Efficacy of integrative respiratory rehabilitation training in exercise ability and quality of life of patients with chronic obstructive pulmonary disease in stable phase: a randomized controlled trial. *Journal of Chinese Integrative Medicine* 2010;**8**(5):432-7.

Yamanaka 2009 *{published data only}*

Yamanaka Y, Ishikawa A, Miyasaka T, Totsu Y, Urabe Y, Inui K. The effect of unsupervised home exercise program for patients with chronic obstructive pulmonary disease. *Nippon Ronen Igakkai Zasshi - Japanese Journal of Geriatrics* 2009;**46**(2):154-9.

Yan 1996 *{published data only}*

Yan Q, Sun Y. Quantitative research for improving respiratory muscle contraction by breathing exercise. *Chinese Medical Journal* 1996;**109**(10):771-5.

Yosbauran 1996 *{published data only}*

Yosbauran N, Cimrin A, Tureyen ZC, Elci OC, Kostek N, Ozsoz A, et al. Evaluation of the impact of group exercises on the quality of life in patients with chronic obstructive pulmonary disease. *European Respiratory Journal* 1996;**9**(Suppl 23):381S.

Zanini 2002 *{published data only}*

Zanini A, Giorgetti G, Facchetti C, Mazzucchelli G, Conti S, Lucioni A, et al. Efficacy of a rehabilitation program based on circuit training in COPD subjects: a preliminary report. *American Journal of Respiratory and Critical Care Medicine* 2002;**165**(Suppl 8):A738.

Zhang 2008 *{published data only}*

Zhang ZQ, Chen RC, Yang QK, Li P, Wang CZ, Zhang ZH. A randomized controlled trial study of pulmonary rehabilitation with respiratory physiology as the guide on prognosis in patients with chronic obstructive pulmonary disease. *Chinese Critical Care Medicine* 2008;**20**(10):607-10.

References to studies awaiting assessment

Aksu 2006 *{published data only}*

Aksu B, Inanir M, Basyigit I, Dursun N, Yildiz F. Comparison of two different exercise programs in chronic obstructive pulmonary disease [Abstract]. *European Respiratory Journal* 2006;**28(Suppl 50)**(5555c):3198.

D'Amico 2010 *{published data only}*

D'Amico F, Grasso R, Chirafisi F. Adapted physical activity in elderly people with chronic obstructive bronchopneumopathy and hypertension.. *High Blood Pressure and Cardiovascular Prevention* 2010;**17**(3):131-90.

Meshcheryakova 2010 *{published data only}*

Meshcheryakova N, Belevskiy A, Cherniak A, Semashko O. The role of exercise and respiratory training on the depression level in COPD patients [Abstract]. *European Respiratory Society 20th Annual Congress; 2010 Sep 18-22; Barcelona* 2010;**18**(22):632.

Meshcheryakova 2012 *{published and unpublished data}*

Meshcheryakova N, Belevskiy A, Cherniak A. Physical training is a universal method of pulmonary rehabilitation of patients with chronic obstructive pulmonary disease]. [Russian]. *Terapevticheskii Arkhiv* 2012;**3**:17-21.

Ren 2011 *{published data only}*

Ren L, Li QY, Du JB, Zhou JM, Weng QL, Chen XH. Comparison of different strategies of pulmonary rehabilitation for patients with COPD of different severity. *Journal of Shanghai Jiaotong University (Medical Science)* 2011;**31**(5):620-4.

References to ongoing studies

Chang 2008 *{published data only}*

Chang AT, Haines T, Jackson C, Yang I, Nitz J. Rationale and design of the PRSM study: pulmonary rehabilitation or self management for chronic obstructive pulmonary disease (COPD), what is the best approach?. *Contemporary Clinical Trials* 2008;**29**(2):796-800.

Gurgun 2011 *{published data only}*

Gurgun A, Tuncel S, Korkmaz Ekren P, Deniz PS, Karapolat H, Kayahan B. Efficacy of an eight-week pulmonary rehabilitation in COPD patients: an experience of a single center In Turkey. *American Journal of Respiratory and Critical Care Medicine* 2011;**183**:A5049.

Sathyapala 2008 *{published data only}*

Sathyapala SA, Marsh GS, Seymour JM, Moxham J, Polkey MI. Effect of repetitive magnetic stimulation training of the quadriceps, compared with exercise therapy, on quadriceps strength in patients with chronic obstructive pulmonary disease. *Thorax* 2008;**63**:A16-A17.

Additional references

AACVPR 2011

AACVPR. Guidelines for Pulmonary Rehabilitation Programs. 4th Edition. Chicago, IL: American Association of Cardiovascular and Pulmonary Rehabilitation, 2011.

Agusti 2003

Agusti AGN, Noguera A, Sauleda E, Sala E, Pons J, Busquets X. Systemic effects of chronic obstructive pulmonary disease. *European Respiratory Journal* 2003;**21**:347-60.

Agusti 2005

Agusti AGN. COPD, a multicomponent disease: implications for management. *Respiratory Medicine* 2005;**99**:670-82.

ATS 1999

American Thoracic Society. Pulmonary rehabilitation. *American Journal of Respiratory and Critical Care Medicine* 1999;**159**:1666-82.

Beauchamp 2011

Beauchamp MK, Janaudis-Ferreira T, Goldstein RS, Brooks D. Optimal duration of pulmonary rehabilitation for individuals with chronic obstructive pulmonary disease - a systematic review. *Chronic Respiratory Disease* 2011;**8**(2):129-400.

Bolton 2013

Bolton CE, Bevan-Smith EF, Blakey JD, et al. British Thoracic Society guideline on pulmonary rehabilitation in adults. *Thorax* 2013;**68**:ii1–ii30.

Bourbeau 2003

Bourbeau J, Julien M, Maltais F, Rouleau M, Beaupre A, Begin R, et al. Reduction of hospital utilization in patients with chronic obstructive pulmonary disease: a disease-specific self-management intervention. *Archives of Internal Medicine* 2003;**163**:585-91.

Bourbeau 2007

Bourbeau J, Nault D. Self-management strategies in chronic obstructive pulmonary disease. *Clinics in Chest Medicine* 2007;**28**(3):617-28.

Bourbeau 2010

Bourbeau J. Making pulmonary rehabilitation a success in COPD. *Swiss Medical Weekly* 2010;**140**:w13067.

British Thoracic Society 2001

British Thoracic Society Standards of Care Committee. Pulmonary rehabilitation. British Thoracic Society Standards of Care Subcommittee on Pulmonary Rehabilitation. *Thorax* 2001;**56**:827-34.

Brooks 2002

Brooks D, Krip B, Mangovski-Alzamora S, Goldstein RS. The effect of post-rehabilitation programmes among individuals with chronic obstructive pulmonary disease. *European Respiratory Journal* 2002;**20**(1):20-9.

Brooks 2007

Brooks D, Sottana R, Bell B, Hanna M, Laframboise L, Selvanayagarajah S, et al. Characterization of pulmonary rehabilitation programs in Canada in 2005. *Canadian Respiratory Journal* 2007;**14**(2):87-92.

Casaburi 1991

Casaburi R, Patessio A, Loli F, Zanaboni S, Donner CF, Wasserman K. Reductions in exercise lactic acidosis and ventilation as a result of exercise training in patients with obstructive lung disease. *American Review of Respiratory Disease* 1991;**143**:9-18.

Casaburi 2009

Casaburi R, ZuWallack R. Pulmonary rehabilitation for management of chronic obstructive pulmonary disease. *New England Journal of Medicine* 2009;**360**(13):1329-35.

Casanova 2011

Casanova C, de Torres JP, Aguirre-Jaíme A, Pinto-Plata V, Marin JM, Cordoba E. The progression of chronic obstructive pulmonary disease is heterogeneous: the experience of the BODE cohort. *American Journal of Respiratory and Critical Care Medicine* 2011;**184**(9):1015-21.

Corrado 1995

Corrado A, Gorini M, De Paola E, Martorana P, Villella G, Augustynen A, et al. Effects of a short outpatient pulmonary rehabilitation program (PRP) in severe COPD patients with chronic respiratory insufficiency (CRI). *European Respiratory Journal* 1995;**8**(Suppl 19):126S.

Curtis 2003

Curtis JR, Patrick DL. The assessment of health status among patients with COPD. *European Respiratory Journal* 2003;**21:**(Suppl. 41):36s–45s.

de Torres 2002

de Torres JP, Pinto-Plata V, Ingenito E, Bagley P, Gray A, Berger R, et al. Power of outcome measurements to detect clinically significant changes in pulmonary rehabilitation of patients with COPD. *Chest* 2002;**121**:1092-8.

Egger 1997

Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. *BMJ* 1997;**13**(315):629-34.

Eisner 2010

Eisner MD, Anthonisen N, Coultas D, Kuenzli N, Perez-Padilla R, Postma D, et al. An official American Thoracic Society public policy statement. Novel risk factors and the global burden of chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine* 2010;**182**(5):693-718.

Fernández 1998

Fernández J, Martín M, Moreno LF. Evaluation of a home-based rehabilitation program controlled with pulse-meter in COPD. *Neumosur* 1998;**10**(1):54-5.

Ferreira 2012

Ferreira IM, Brooks D, White J, Goldstein R. Nutritional supplementation for stable chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews* 2012, Issue 12. [DOI: 10.1002/14651858.CD000998.pub3]

Fishman 1994

Fishman AP. Pulmonary rehabilitation research. *American Journal of Respiratory and Critical Care Medicine* 1994;**149**:825-33.

Forey 2011

Forey BA, Thornton AJ, Lee PN. Systematic review with meta-analysis of the epidemiological evidence relating smoking to COPD, chronic bronchitis and emphysema. *BMC Pulmonary Medicine* 2011;**11**:36.

Franchi 2009

Franchi M. EFA book on chronic obstructive pulmonary disease in Europe: sharing and caring. Brussels: European Federation of Allergy and Airways Disease. http://www.efanet.org/documents/EFACOPDBook.pdf (accessed 23 October 2014).

Garcia-Aymerich 2006

Garcia-Aymerich J, Lange P, Benet M, Schnohr P, Anto JM. Regular physical activity reduces hospital admission and mortality in chronic obstructive pulmonary disease: a population based cohort study. *Thorax* 2006;**61**(9):772-8.

GOLD 2014

Global Initiative for Chronic Obstructive Lung Disease (GOLD). Global Strategy for the Diagnosis, Management and prevention of Chronic Obstructive Pulmonary Disease. http://www.goldcopd.org/uploads/users/files/GOLD_Report_2014_Jun11.pdf (accessed 24 October 2014).

Gross 2004

Gross NJ. Outcome measures for COPD treatments; a critical evaluation. *COPD* 2004;**1**:41-57.

Guarascio 2013

Guarascio AJ, Ray SM, Finch CK, Self TH. The clinical and economic burden of chronic obstructive pulmonary disease in the USA. *Clinicoeconomics and Outcomes Research* 2013;**5**:235–45.

Guell 2000

Guell R, Casan P, Belda J, Sangenis M, Morante F, Guyatt GH, et al. Long-term effects of outpatient rehabilitation of COPD: a randomized trial. *Chest* 2000;**117**(4):976-83.

Guyatt 1984

Guyatt GH, Pugsley SO, Sullivan MJ, Thompson PJ, Berman LB, Jones NL, et al. Effect of encouragement on walking test performance. *Thorax* 1984;**39**:818-22.

Guyatt 1985

Guyatt GH, Thompson PJ, Berman LB, Sullivan MJ, Townsend M, Jones NL, et al. How should we measure function in patients with chronic heart and lung disease?. *Journal of Chronic Diseases* 1985;**38**:517-24.

Guyatt 1987a

Guyatt GH, Berman LB, Townsend M, Pugsley SO, Chambers LW. A measure of quality of life for clinical trials in chronic lung disease. *Thorax* 1987;**42**:773-8.

Harper 1997

Harper R, Brazier JE, Waterhouse JC, Walters SJ, Jones NM, Howard P. Comparison of outcome measures for patients with chronic obstructive pulmonary disease (COPD) in an outpatient setting. *Thorax* 1997;**52**:879-87.

Higgins 2011

Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. www.cochrane-handbook.org.

Holland 2014

Holland AE, Spruit MA, Troosters T, Puhan MA, Pepin V, et al. An official European Respiratory Society/American Thoracic Society technical standard: field walking tests in chronic respiratory disease. *European Respiratory Journal* 2014;**44**:1428–46.

Jaeschke 1989

Jaeschke R, Singer J, Guyatt GH. Measurement of health status: ascertaining the minimal clinically important difference. *Controlled Clinical Trials* 1989;**10**:407-15.

Jones 1988

Jones NL. Approaches to clinical exercise testing. Clinical Exercise Testing. Philadelphia: WB Saunders, 1988:123-34.

Jones 1991

Jones PW, Quirk FH, Baveystock CM. The St George's Respiratory Questionnaire. *Respiratory Medicine* 1991;**85**(Suppl B):25-31.

Jones 1992

Jones PW, Quirk FH, Baveystock CM, Littlejohns P. A self-complete measure of health status for chronic airflow limitation. The St. George's Respiratory Questionnaire. *American Review of Respiratory Disease* 1992;**145**:1321-7.

Jones 2003

Jones PW, Kaplan RM. Methodological issues in evaluating measures of health as outcomes for COPD. *European Respiratory Journal* 2003;**21**(Suppl 41):13s–18s.

Kew 2014

Kew KM, Seniukovich A. Inhaled steroids and risk of pneumonia for chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews* 2014, Issue 3. [DOI: 10.1002/14651858.CD010115.pub2]

Kirshner 1985

Kirshner B, Guyatt G. A methodological framework for assessing health indices. *Journal of Chronic Diseases* 1985;**38**:27-36.

Kramer 1981

Kramer MS, Feinstein AR. Clinical biostatistics. LIV. The biostatistics of concordance. *Clinical Pharmacology and Therapeutics* 1981;**29**:111-23.

Lacasse 1997

Lacasse YL, Wong E, Guyatt GH, Goldstein RS. Health-status measure instruments in chronic obstructive pulmonary disease. *Canadian Respiratory Journal* 1997;**4**:152-64.

Lotters 2002

Lotters F, van Tol B, Kwakkel G, Gosselink R. Effects of controlled inspiratory muscle training in patients with COPD: a meta-analysis. *European Respiratory Journal* 2002;**20**:570-6.

Mahler 1984

Mahler DA, Weinberg DH, Wells CK, Feinstein AR. The measurement of dyspnea. Contents, interobserver agreement, and physiologic correlates of two new clinical indexes. *Chest* 1984;**85**:751-8.

Maltais 1996

Maltais F, LeBlanc P, Simard C, Jobin J, Berube C, Bruneau J, et al. Skeletal muscle adaptation to endurance training in patients with chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine* 1996;**154**:442-7.

Maltais 2008

Maltais F, Bourbeau J, Shapiro S, Lacasse Y, Perrault H, Baltzan M, et al. Effects of home-based pulmonary rehabilitation in patients with chronic obstructive pulmonary disease: a randomized trial. *Annals of Internal Medicine* 2008;**149**(12):869-78.

NICE 2010

National Clinical Guideline Centre. Chronic obstructive pulmonary disease: management of chronic obstructive pulmonary disease in adults in primary and secondary care. London: National Clinical Guideline Centre,. London: National Clinical Guideline Centre, 2010.

Nici 2006

Nici L, Donner C, Wouters E, Zuwallack R, Ambrosino N, Bourbeau J. American Thoraic Society/European Respiratory Society statement on pulmonary rehabilitation. *American Journal of Respiratory and Critical Care Medicine* 2006;**173**:1390–413.

Nishimura 2013

Nishimura K, Mitsuma S, Kobayashi A, Yanagida M, Nakayasu K, Hasegawa Y, et al. COPD and disease-specific health status in a working population. *Respiratory Research* 1013;**14**:61.

O' Donnell 2007

O'Donnell DE, Aaron S, Bourbeau J, Hernandez P, Marciniuk DD, Balter M, et al. Canadian Thoracic Society recommendations for management of chronic obstructive pulmonary disease - 2007 update. *Canadian Respiratory Journal* 2007;**14**(Suppl B):5B-32B.

Pauwels 2001

Pauwels RA, Buist AS, Calverley PM, Jenkins CR, Hurd SS. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. NHLBI/WHO Global Initiative for Chronic Obstructive Lung Disease (GOLD) Workshop summary. *American Journal of Respiratory and Critical Care Medicine* 2001;**163**(5):1256-76.

Puhan 2011(a)

Puhan MA, Gimeno-Santos E, Scharplatz M, Troosters T, Walters EH, Steurer J. Pulmonary rehabilitation following exacerbations of chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews* 2011, Issue 10. [DOI: 10.1002/14651858.CD005305.pub3]

Puhan 2011(b)

Puhan MA, Chandra D, Mosenifar z Reis A, Make B, Hansel NN, Wise RA, et al. The minimal important difference of exercise tests in severe COPD. *European Respiratory Journal* 2011;**37**(4):784-90.

Quirk 1991

Quirk FH, Baveystock CM, Wilson RC, Jones PW. Influence of demographic and disease related factors on the degree of distress associated with symptoms and restrictions on daily living due to asthma in six countries. *European Respiratory Journal* 1991;**4**:167-71.

Ram 2005

Ram FSF, Jardinb JR, Atallahc A, Castrod AA, Mazzinie R, Goldsteinf R, et al. Efficacy of theophylline in people with stable chronic obstructive pulmonary disease: a systematic review and meta-analysis. *Respiratory Medicine* 2005;**99**:135-44.

Redelmeier 1997

Redelmeier DA, Bayoumi AM, Goldstein RS, Guyatt GH. Interpreting small differences in functional status: the Six Minute Walk test in chronic lung disease patients. *American Journal of Respiratory and Critical Care Medicine* 1997;**155**:1278-82.

RevMan 2011 [Computer program]

Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2011. Review Manager (RevMan). Version 5.1. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2011, 2011.

Ries 2003

Ries AL, Kaplan RM, Myers R, Prewitt LM. Maintenance after pulmonary rehabilitation in chronic lung disease: a randomized trial. *American Journal of Respiratory and Critical Care Medicine* 2003;**167**(6):880-8.

Ries 2007

Ries AL, Bauldoff GS, Carlin BW, Casaburi R, Emery CF, Mahler DA, et al. Pulmonary rehabilitation: joint ACCP/AACVPR evidence-based clinical practice guidelines. *Chest* 2007;**131**(5 Suppl):4s-42s.

Rochester 2014

Rochester CL, Spanevello A. Heterogeneity of pulmonary rehabilitation: like apples and oranges - both healthy fruit. *European Respiratory Journal* 2014;**43**(5):1223-6.

Rutten-van Mölken 1999

Rutten-van Mölken M, Roos B, Van Noord JA. An empirical comparison of the St-George's Respiratory Questionnaire (SGRQ) and the Chronic Respiratory Disease Questionnaire (CRQ) in a clinical setting. *Thorax* 1999;**54**:995-1003.

Schulz 1995

Schulz KF, Chalmers I, Hayes RJ, Altman DG. Empirical evidence of bias - Dimensions of methodological quality associated with estimates of treatment effects in controlled trials. *JAMA* 1995;**273**:408-12.

Shadish 1994

Shadish WR, Haddock CK. Combining estimates of effect size. In: Cooper H, Hedges LV editor(s). The Handbook of Research Synthesis. New York: Russel Sage Foundation, 1994:261-81.

Shu 1998

Shu MF, Kao CH, Kuo HP. Upper arm exercise improves exercise tolerance and dyspnea sensation in patients with chronic obstructive airway disease (COAD). *European Respiratory Journal* 1998;**12**(Suppl 28):406S.

Singh 2008

Singh S J, Jones PW, Evans R, Morgan MDL. The minimum clinically important improvement for the incremental shuttle walking test. *Thorax* 2008;**63**(9):775-7.

Singh 2014

Singh SJ, Puhan MA, Adrianopoulos V, Hernandes NA, Mitchell KE, Hill CJ, Lee AL, et al. An official systematic review of the European Respiratory Society/American Thoracic Society: measurement properties of field walking tests in chronic respiratory disease. *European Respiratory Journal* 2014;**44**:1447-78.

Spruit 2013

Spruit MA, Singh SJ, Garvey C, ZuWallack R, Nici L, Rochester C. An official American Thoracic Society/European Respiratory Society statement: key concepts and advances in pulmonary rehabilitation. *American Journal of Respiratory and Critical Care Medicine* 2013;**188**(8):e13-e64.

Spruit 2014

Spruit MA, Pitta F, Garvey C, ZuWallack RL, Roberts CM, Collins, EG, et al. Differences in content and organisational aspects of pulmonary rehabilitation programmes. *European Respiratory Journal* 2014;**43**(5):1326-37.

Stanton 1995

Stanton M, Beauchamp C, Weinberger M. A randomized controlled trial of pulmonary rehabilitation in chronic obstructive airways disease. *Journal of General Internal Medicine* 1995;**10**(Suppl):50.

Steiner 2003

Steiner MC, Barton RS, Singh SJ, Morgan MDL. Nutritional enhancement of exercise performance in chronic obstructive pulmonary disease: a randomised controlled trial. *Thorax* 2003;**58**(9):745-51.

Taylor 2005

Taylor SJ, Candy B, Bryar RM, Ramsay J, Vrijhoef HJ, Esmond G, et al. Effectiveness of innovations in nurse led chronic disease management for patients with chronic obstructive pulmonary disease: systematic review of evidence. *BMJ* 2005;**331**:485-91.

Tregonning 2000

Tregonning M, Roberts S, Langley C, Dawe C, Rossdale C, Harvey JE, et al. Randomised controlled trial of home exercise and education in chronic obstructive pulmonary disease (COPD). *Thorax* 2000;**55**(Suppl 3):A7.

Troosters 2000

Troosters T, Gosselink R, Decramer M. Short-and long-term effects of outpatient rehabilitation in patients with chronic obstructive pulmonary disease: a randomized trial. *American Journal of Medicine* 2000;**109**(3):207-12.

Viera 2010

Vieira DS, Maltais F, Bourbeau J. Home-based pulmonary rehabilitation in chronic obstructive pulmonary disease patients. *Current Opinion in Pulmonary Medicine* 2010;**16**(2):134-43.

Ward 1999

Ward H, Dunsmore J, Thomas K, Sourdin S, Norton K, Wilson C, et al. A randomised controlled trial of pulmonary rehabilitation in moderate to severe chronic airflow limitation (CAL). *Respirology* 1999;**4**:A4.

Waschki 2011

Waschki B, Kirsten A, Holz O, Müller KC, Meyer T, Watz H, et al. Physical activity is the strongest predictor of all-cause mortality in patients with COPD: a prospective cohort study. *Chest* 2011;**140**:331-42.

Watson 1997

Watson PB, Town GI, Holbrook N, Dwan C, Toop LJ, Drennan CJ. Evaluation of a self-management plan for chronic obstructive pulmonary disease. *European Respiratory Journal* 1997;**10**:1267-71.

Whiteford 2004

Whiteford S. Evaluation of the effect of a home-based, cognitive-behavioural pulmonary rehabilitation programme on physiological and psychosocial outcomes in COPD patients [N0394118760]. National Research Register 2004.

WHO 2008

World Health Organization. World Health Stastistics. 2008; Vol. http://www.who.int/gho/publications/world_health_statistics/EN_WHS08_Full.pdf?ua=1, issue accessed 17 November 2014.

Wijkstra 1994a

Wijkstra PJ, Tenvergert EM, van der Mark TW, Postma DS, Van Altena R, Kraan J. Relation of lung function, maximal inspiratory pressure, dyspnoea, and quality of life with exercise capacity in patients with chronic obstructive pulmonary disease. *Thorax* 1994;**49**:468-72.

Wijkstra 1995

Wijkstra PJ, Ten Vergert EM, van Altena R, Otten V, Kraan J, Postma DS. Long term benefits of rehabilitation at home quality of life and exercise tolerance in patients with chronic obstructive pulmonary disease. *Thorax* 1995;**50**:824-8.

Wright 2002

Wright PR, Heck H, Langenkamp H, Franz KH, Weber U. Effect of a resistance training on pulmonary function and performance measures in patients with COPD [Einfluß eines Krafttrainings auf Lungenfunktionsparameter und Größen der Leistungfähigkeit von COPD Patienten]. *Pneumologie* 2002;**56**:413-7.

Yohannes 2004

Yohannes AM, Connolly MJ. Pulmonary rehabilitation programmes in the UK: a national representative survey. *Clinical Rehabilitation* 2004;**18**:444-9.

References to other published versions of this review

Lacasse 1996

Lacasse Y, Wong E, Guyatt GH, King D, Cook DJ, Goldstein RS. Meta-analysis of respiratory rehabilitation in chronic obstructive pulmonary disease. *The Lancet* 1996;**348**:1115-9.

Lacasse 2001

Lacasse Y, Brosseau L, Milne S, Martin S, Wong E, Guyatt GH, et al. Pulmonary rehabilitation for chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews* 2001, Issue 4. [DOI: 10.1002/14651858.CD003793]

Lacasse 2006

Lacasse Y, Goldstein RS, Lasserson TJ, Sylvie M. Pulmonary rehabilitation for chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews* 2006, Issue 3. [DOI: 10.1002/14651858.CD003793.pub2]

* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Barakat 2008

Methods	**Study design:** RCT

Barakat 2008 *(Continued)*

	"Randomization was in blocks of 10, using random numbers" (pg 157)
Participants	**Setting:** out-patients in France **Inclusion criteria:** • Participants accepted into the study were known to the respiratory team at the hospital as having long-standing airway disease, classified as COPD **Exclusion criteria:** • Unstable medical conditions such as congestive cardiac failure, cor pulmonale, malignancy or cerebrovascular accident • Individuals with sleep apnoea syndrome **Participant status:** Age, years: RG: 63.7; CG: 65.9 Gender (M/F): 67/13 FEV_1 % predicted: RG: 41.9; CG: 43.3 **Participants randomly assigned:** Randomised: 80 Analysed Rehab: 35 Control: 36
Interventions	**Pulmonary rehabilitation:** Out-patient-based rehabilitation ULE, LLE, Edu Duration: 14-Week programme
Outcomes	**Assessed:** baseline and 14 weeks Spirometry, SGRQ, 6MWT, Bode Index
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Randomization was in blocks of 10, using random numbers" (pg 157)
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	The nature of the intervention made it impossible to blind participants to their allocation

Barakat 2008 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Low risk	"All tests including SGRQ outcome assessment [were] blinded" (pg 150) "All of these tests were supervised by a blinded observer, who subsequently repeated this assessment before the study and at the end of the study (0 and 14 weeks)" (pg 156)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Commenced: 80; completed: 71; attrition: 11.25%
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None noted

Baumann 2012

Methods	**Study design:** prospective, randomised, controlled, interventional, multi-centre trial
Participants	**Setting:** Hamburg metropolitan area, multi-centre trial **Inclusion criteria:** • Age between 50 and 80 years • COPD GOLD stage II-IV • Smoking history of > 20 pack-years • Pharmacological therapy according to current guidelines • Written informed consent **Exclusion criteria:** • Respiratory insufficiency, defined as PaO_2 < 55 mmHg and/or $PaCO_2$ > 50 mmHg breathing room air • Manifest cardiac insufficiency • Uncontrolled arterial hypertension • Active malignant disease • Symptomatic coronary heart disease or pathological test results in cycle ergometry • Limited physical capabilities • Musculoskeletal disorders as the cause • Unwillingness to return for follow-up • Previous or ongoing participation in exercise training programmes • Expected inability to attend at least 75% of sessions **Participant status:** Age, years: RG: 65; CG: 63 Gender (M/F): 47/34 FEV_1 % predicted: RG: 45; CG:47 **Participants randomly assigned:** Randomised: 100 Analysed Rehab: 37

Baumann 2012 *(Continued)*

	Control: 44
Interventions	**Pulmonary rehabilitation:** Out-patient (hospital based) Aerobic exercise, ULE, LLE Edu, peer support Duration: 8 sessions of 20 minutes and 18 sessions of 60 minutes **Usual care:** Standard care consisted of referral back to the participant's pulmonologist following baseline assessments. The control group did not take part in any components of the rehabilitation programme
Outcomes	**Assessed:** baseline and 6 months 6-Minute walk test (6MWT) Cycle ergometry Short Form-12 (SF-12), SGRQ
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Randomisation was performed using a computer-generated list of random numbers to assign participants to either training or standard care" (pg 3)
Allocation concealment (selection bias)	High risk	"Consecutive patients with COPD according to accepted criteria [5] were recruited" (pg 3)
Blinding of participants and personnel (performance bias) All outcomes	High risk	"Due to the nature of the intervention it was not possible to blind subjects to their allocation (pg 2)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Those supervising the 6MWT were not blinded, whereas those supervising cycle ergometry were blinded
Incomplete outcome data (attrition bias) All outcomes	High risk	Commenced: 42; completed: 32; attrition: 10 (24%)
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None noted

Behnke 2000a

Methods	**Study design:** RCT

Behnke 2000a *(Continued)*

Participants	**Setting:** work undertaken in Germany **Inclusion criteria:** • Severe COPD • Following acute episode **Exclusion criteria:** • Evidence of unstable cardiac disease, cor pulmonale decompensation • Other disabling diseases that prevented participation in the exercise programme, such as orthopaedic inabilities or peripheral vascular disease **Participant status:** Age, (years± SD): RG: 64.0 ± 1.9; CG: 68.0 ± 2.2 Gender (M/F): RG: 12/3; CG: 11/4 FEV_1 % predicted (± SD): RG: 34.1 ± 7.4; 37.5 ± 6.6 **Participants randomly assigned:** In-patient and home-based Randomised: 46 Analysed Rehab: 15 Control: 15
Interventions	**Pulmonary rehabilitation:** acute hospital admission followed by home exercise programme for 6 months LLE, Edu, Psy Duration: 24 weeks **Usual care:** Control participants were advised to perform exercise but without special instructions
Outcomes	**Assessment:** baseline and 3, 6 months 6MWT, CRQ
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was in blocks of 10, using random numbers (from study authors)
Allocation concealment (selection bias)	Low risk	Randomisation process: sealed envelopes (from study authors)
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the programme knew the allocation

Behnke 2000a *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Does not provide information on blinding of assessors, other than that main researcher undertook assessments "the questionnaire was administered as a structured interview, and all interviews were performed by the same investigator (M.B.)" (pg 11867)
Incomplete outcome data (attrition bias) All outcomes	High risk	Commenced :46; completed: 30; attrition:16 (35%)
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None reported

Bendstrup 1997

Methods	**Study design:** RCT
Participants	**Setting:** Patients came for out-patient rehabilitation to a hospital in Denmark **Inclusion criteria:** • Forced expiratory volume in 1 second (FEV_1) between 25% and 55% of predicted value for age, gender and height • Tiffenau index (FEV_1/forced vital capacity (FVC) ratio) < 70% • Stable condition for at least 4 weeks • No change in exercise status, sputum colour and quantity; no changes in medication **Exclusion criteria:** • Heart disease (moderate or severe ischaemic heart disease, acute myocardial infarction within 3 months, cardiomyopathy and valvular heart disease) • Musculoskeletal disease limiting exercise • Intermittent claudication limiting exercise **Participant status:** Age, (years ± SD): RG: 64 ± 3; CG: 65 ± 2 Gender (M/F): RG: 7/9; CG: 7/9 **Participants randomly assigned:** Randomised: 42 Analysed Rehab: 16 Control: 16
Interventions	**Pulmonary rehabilitation:** out-patient LLE, ULE, IMT Duration: 12 weeks **Control:** Stated that care was provided by primary physician

Bendstrup 1997 *(Continued)*

Outcomes	**Assessment:** baseline and 12 weeks 6MWT, CRQ, activities of daily living, York QLQ
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No information provided other than this: "The patients were randomly allocated to either an intervention or a control group"
Allocation concealment (selection bias)	Unclear risk	Information not available
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the programme knew the allocation
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information was provided in relation to blinding of those carrying out outcome assessments
Incomplete outcome data (attrition bias) All outcomes	High risk	Commenced: 42; completed: 32; attrition: 10 (24%)
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None noted

Booker 1984

Methods	**Study design:** RCT
Participants	**Setting:** home-based UK study in London **Inclusion criteria:** • Patients with CAL and exercise tolerance limited by breathlessness were accepted into the study **Exclusion criteria:** • Not provided **Participant status:** Age, (years±SD) : RG: 66± 8; CG: 65 ± 7 Gender: not available **Participants randomly assigned:** Randomised: 69

Booker 1984 *(Continued)*

	Analysed Rehab: 32 Control: 37
Interventions	**Pulmonary rehabilitation:** LLE, BE, PD, Edu, Psy Duration: 9 weeks
Outcomes	**Assessment:** baseline and 3, 6, 12 months 6MWT, DSSI/SAD, daily activity questionnaire
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation process: coin toss
Allocation concealment (selection bias)	Low risk	Study investigators unaware as to order of treatment group assignment
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the programme knew the allocation
Blinding of outcome assessment (detection bias) All outcomes	Low risk	All assessments were carried out by independent assessors who were unaware of the treatment received by each participant - "double-blind" (pg 258)
Incomplete outcome data (attrition bias) All outcomes	High risk	Commenced: 128; completed: 94 (73%); attrition: 27%
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None noted

Borghi-Silva 2009

Methods	**Study design:** prospective randomised controlled trial
Participants	**Setting:** Brazil **Inclusion criteria:** • Diagnosis of COPD according to criteria set forth by GOLD • Compliance with medical management • No change in medical management and no decompensation episodes for at least 1 month before study initiation • No participation in a regular physical exercise programme for at least 6 months before study initiation

Borghi-Silva 2009 *(Continued)*

Exclusion criteria:

- Presence of orthopaedic or neurological conditions that would preclude participation in an exercise programme
- History of cardiac arrhythmias or potential ECG alterations
- Past history consistent with heart disease, diabetes mellitus, uncontrolled hypertension or other concomitant respiratory diseases
- Failure to comply with the research protocol

Participant status:

Age (years): RG: 67 ±10; CG: 67 ± 10

Gender (M/F): RG: 13/7; CG: 12/8

FEV_1 % predicted (± SD): RG: 64 ± 16; CG: 64 ± 18

Participants randomly assigned:

Randomised: 40

Analysed:

Rehab: 20
Control: 20

Interventions	**Pulmonary rehabilitation:** Out-patient (hospital-based) supervised training programme Aerobic exercise, ULE, LLE Duration: 6-week programme **Usual care**
Outcomes	**Assessed:** baseline and 6 weeks 6-Minute walk ReR intervals
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No information available
Allocation concealment (selection bias)	Unclear risk	No information available
Blinding of participants and personnel (performance bias) All outcomes	High risk	Unable to blind because of the nature of the intervention
Blinding of outcome assessment (detection bias)	Unclear risk	No information available

Borghi-Silva 2009 *(Continued)*

All outcomes		
Incomplete outcome data (attrition bias) All outcomes	Low risk	Commenced: 40; completed: 34; attrition: 6 (15%)
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Unclear risk	None noted

Boxall 2005

Methods	**Study design:** RCT
Participants	**Setting:** home-based PR programme in Australia **Inclusion criteria:** • Diagnosis of COPD by 1 of 4 hospital respiratory specialists • Older than 60 years • Dyspnoea on exertion • Live locally • Free from worsening symptoms of disease over the past 2 weeks • Motivated to exercise daily unsupervised **Exclusion criteria:** • Attending out-patient-based pulmonary rehabilitation • Restricted shoulder movement • Living in a nursing home • Previous lung volume reduction surgery • Pain limiting mobility **Participant status:** Gender (M/F): RG: 11/12; CG: 15/8 Age (years±SD): RG: 77.6 ±7.6; CG: 75.8 ±8.1 FEV_1 % predicted (± SD): RG: 40.5 ±15.9; CG: 37.7 ±15.0 FEV_1/FVC % predicted (± SD): RG: 74.4 ± 21.3; CG: 70.4 ± 19.2 **Participants randomly assigned:** Randomised: 60 Analysed: Rehab: 23 Control: 23
Interventions	**Pulmonary rehabilitation:** supervised home-based ULE, LLE, Edu Duration: 12 weeks **Usual care:**

Boxall 2005 *(Continued)*

	Control phase: Participants received no treatment in addition to usual medical care
Outcomes	**Assessed:** baseline and 12 weeks 6MWT, SGRQ, dyspnoea
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"computer-generated random numbers that were coded into opaque envelopes by a person independent from the study, they retained the envelopes until initial assessment was completed" (pg 380)
Allocation concealment (selection bias)	Low risk	Study investigators unaware as to order of treatment group: "computer-generated random numbers that were coded into opaque envelopes by a person independent from the study, they retained the envelopes until initial assessment was completed" (pg 380)
Blinding of participants and personnel (performance bias) All outcomes	High risk	"Neither assessors nor participants were blinded to group assignment in this study" (pg 380)
Blinding of outcome assessment (detection bias) All outcomes	High risk	"Neither assessors nor participants were blinded to group assignment in this study" (pg 380)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Commenced: 60; completed: 46 (76.7%); attrition: 23.3%
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	High risk	"Had to live locally might bias the sample selection and be motivated to exercised daily" (pg 379)

Busch 1988

Methods	**Study design:** RCT stratified in a random manner
Participants	**Setting:** home-based; Saskatchewan, Canada **Inclusion criteria:** • Severe, irreversible airway obstruction **Exclusion criteria:** • Without apparent or symptomatic ischaemic heart disease or disablement from medical conditions other than COPD **Participant status:** Age (years ± SD): RG: 65 ±16; CG: 66 ±16

Busch 1988 *(Continued)*

	Gender (M/F): RG: 5/2; CG: 6/1 FEV_1 (± SD): RG: 26% ± 9; CG: 27% ±11 **Participants randomly assigned:** Randomised: 14 Analysed: Rehab: 6 Control: 6
Interventions	**Pulmonary rehabilitation:** LLE, BE Duration: 18 weeks **Usual care:** Control group visited but did not follow the exercise programme
Outcomes	**Assessment:** baseline and at 18 weeks CRQ (dyspnoea only), ICET, multi-step stage test
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Letter received from study author: used a table of random numbers
Allocation concealment (selection bias)	Low risk	Study investigators unaware as to order of treatment group assignment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Both participants and those delivering the intervention were aware of those allocated to the intervention group
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"The testers did not know whether the patients were assigned to the Exercise Group or the Control Group" (pg 470)
Incomplete outcome data (attrition bias) All outcomes	High risk	Commenced: 20; completed: 14; attrition: 6 (30%)
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Unclear risk	None noted

Cambach 1997

Methods	**Study design:** RCT

Cambach 1997 *(Continued)*

Participants	**Setting:** 8 community-based local physiotherapy practices in The Netherlands **Inclusion criteria:** • Evidence of dyspnoea and decreased exercise tolerance as a result of obstructive lung disease • Age 18–75 years • Ability to travel independently to the physiotherapy practice • Medication prescribed by a pulmonary physician; motivation to improve self-care • Informed consent **Exclusion criteria:** • Cardiac complaints or locomotor disabilities • Hypercapnia; arterial carbon dioxide tension ($PaCO_2$) > 6.0 kPa (45 mmHg)) and/or hypoxia; arterial oxygen tension (PaO_2 < 8.7 kPa (65 mmHg)) during rest and/or maximal bicycle exercise testing **Participant status:** Age, (years± SD): RG: 62 ± 5; CG: 62 ± 9 Gender (M/F): RG: 7/8; CG: 6/2 FEV_1 % predicted (± SD): RG: 59% ± 16; CG: 60% ± 23 **Participants randomly assigned:** Randomised: 99 Analysed: Rehab: 15 Control: 8
Interventions	**Pulmonary rehabilitation:** community based LLE, ULE, Edu, IMT Duration: 12 weeks. (3 days a week for 90 minutes) **Usual care:** medication management only
Outcomes	**Assessment:** baseline, 3 months 6MWT, CRQ, ICET
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Within each physiotherapy practice, four out of eight patients were randomly allocated to group RC, and four patients to group CR (block randomisation procedure; four closed envelopes for condition RC and four closed envelopes for condition CR) Baseline assessments were carried out prior to randomisation" (pg 105)
Allocation concealment (selection bias)	Low risk	Study investigators unaware as to order of treatment group assignment "four closed envelopes for condition RC and four closed envelopes for condition CR" (pg 105)

Cambach 1997 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	Both participants and those delivering the intervention were aware of those allocated to the intervention group
Blinding of outcome assessment (detection bias) All outcomes	High risk	Outcome assessments: not blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	No information available
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None identified

Casaburi 2004

Methods	**Study design:** RCT into 4 groups
Participants	**Setting:** out-patient, Los Angeles **Inclusion criteria:** • 55 to 80 years, FEV_1 of 60% predicted or less (13) and FEV_1 to vital capacity ratio of ≤ 60% • Screening serum testosterone was ≤ 400 ng/dL **Exclusion criteria:** • Significant cardiovascular or orthopaedic impairment • Body weight < 75% or > 130% of ideal • Symptomatic benign prostatic hyperplasia, prostate cancer history, serum prostate specific antigen > 4 g/L or haemoglobin > 16 g/dL **Participant status:** Age (years± SD): RG: 69 (10); CG: 68 (9) Gender (M/F):RG: 12/0; CG: 12/0 FEV_1 % predicted: RG: 36% (9); CG: 39% (12) **Participants randomly assigned:** Randomised: 26 Analysed: Rehab: 12 Control: 12
Interventions	**Pulmonary rehabilitation:** out-patient (hospital) LLE, nutritional instruction provided Duration: 10 weeks (3 sessions/wk) **Usual care:**

Casaburi 2004 *(Continued)*

	Placebo injections and no training
Outcomes	**Assessment:** baseline and 10 weeks Peak work rate
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Subjects were randomly assigned to treatment groups based on randomisation tables; randomisation was stratified for age < or ≥ 67 years and FEV_1 < or ≥ 40% predicted" (supplement)
Allocation concealment (selection bias)	Low risk	Study investigators unaware as to order of treatment group assignment (from study author)
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, it was not possible to blind participants to their allocation of exercise or to blind those delivering the exercise
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"Investigators and study coordinators were blinded as to whether subjects received testosterone or placebo" (supplement)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Commenced: 53; completed: 47 (88.7%); attrition: 6 (11.3%)
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None identified

Casey 2013

Methods	**Study design:** 2-Arm, cluster-randomised controlled trial
Participants	**Setting:** community based, West of Ireland **Inclusion criteria:** • Postbronchial dilator FEV_1/FVC ratio < 70%* unless BMI > 30, in which case FEV_1/FVC ratio > 70% is acceptable provided other criteria are fully met and the postbronchial dilator predicted value of FEV_1 ≥ 30% and ≤ 80% **Exclusion criteria:** • Underlying co-morbidities or mental health problems (based on the recorded judgement of practice staff), which are likely to impair their capacity to successfully participate in or assimilate new information as part of the rehabilitation programme, or which may pose a risk to health **Participant status:**

Casey 2013 *(Continued)*

	Age (years± SD): RG: 68.8 ±10.2; CG: 68.4 ± 10.3 Gender (M/F): RG: 117/61; CG: 106/66 FEV_1 % (pred ± SD): RG: 57.6 ±14.3 ; CG: 59.7 ±13.8 **Participants randomly assigned:** Randomised: 350 (16 clusters in control and 16 clusters in intervention) (participants: 178 intervention; 172 control) Analysed: Rehab: 178 Control: 172
Interventions	**Pulmonary rehabilitation:** community based, structured, nurse-led and delivered in the primary healthcare setting Aerobic exercise, ULE, LLE, Edu, phone support, respiratory muscle training Duration: 8 weeks, 2 hours per week **Usual care:** routine GP care
Outcomes	**Assessment:** baseline and 12 weeks Incremental shuttle walking test, CRQ, Self-Efficacy for Managing Chronic Disease 6-item scale EuroQol EQ-5D, utilisation of healthcare service
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Random allocation using computerised random sequence generation" (Casey 2013, pg 3)
Allocation concealment (selection bias)	Low risk	"Group allocation concealment was achieved by giving responsibility for computerised allocation sequence generation and group allocation to a researcher independent of the research team and blinded to baseline outcome data" (Casey 2013, pg 3)
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, unable to blind participants
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"Research assistants trained in outcome assessment, blinded to group allocation" (Casey 2013, pg 3)
Incomplete outcome data (attrition bias) All outcomes	High risk	Commenced: 350; completed: 277 (79%); attrition: 73 (21%)
Selective reporting (reporting bias)	Low risk	Outcomes reported matched the protocol
Other bias	Low risk	None identified

Cebollero 2012

Methods	**Study design:** RCT; randomisation into 3 groups
Participants	**Setting:** 2 centres in Spain **Inclusion criteria:** • Dyspnoea (MMRC grades II-III) • Current non-smoker status • Age 60-80 years **Exclusion criteria:** • Never smoked • Exacerbation of symptoms in the preceding 3 months • Co-existing conditions that might limit exercise tolerance **Participant status:** Age (years): PG: 68 (7); CG: 69 (5) Gender (M/F): all male FEV_1 % (pred): RG: 47.8 (5); REG: 44.3 (11.9); CG: 38.7 (5) **Participants randomly assigned:** Randomised: 36 Combined resistance and endurance group: 14 Resistance alone group: 14 Control: 8 Did not include anyone who did not finish the intervention
Interventions	**Pulmonary rehabilitation:** out-patient programme (hospital-based PR); 3 groups: resistance training alone (n = 14); combined resistance and endurance training (n = 14); and control group (n = 8) Duration: 12 weeks. (twice a week 45-60 minutes) **Usual care**
Outcomes	**Assessment:** baseline and 12 weeks CRQ, 6MWT
Notes	Combined group of REG/RG used in the analysis

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"For each subject included in the study, a researcher picked closed ticket with a number inside (from 1 to 3). The number corresponded to one of the three study groups" (additional information from study author)

Cebollero 2012 *(Continued)*

Allocation concealment (selection bias)	Low risk	Allocation: closed ticket with a number inside (additional information from study author)
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, it is not possible to blind participants
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Yes, according to the study authors
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Did not include anyone who did not finish the intervention; unclear as to attrition
Selective reporting (reporting bias)	Low risk	Provided summary of all outcomes
Other bias	Low risk	

Chan 2011

Methods	**Study design:** single-blind, randomised controlled trial Randomly assigned to 1 of 3 groups (TCQ group, exercise, control)
Participants	**Setting:** 5 general outpatient clinics in Hong Kong **Inclusion criteria:** • Clinically diagnosed with COPD according to the ATS **Exclusion criteria:** • Could not walk independently • Suffered from severe sensory or cognitive impairment • Symptomatic ischaemic heart disease • Practiced TCQ within a year prior **Participant status:** Age (years ± SD): RG: 73.6±7.5; CG: 73.6 ±7.4 Gender (M/F): RG: 61/8; CG: 58/9 FEV_1 % (pred ± SD): RG: 91 ±.39; CG: 89 ±.39 **Participants randomly assigned:** Randomised: 206 (TCQ 70, exercise 69, control 67) Analysed: (only exercise group) Rehab:69 Control: 67
Interventions	**Pulmonary rehabilitation:** community (primary care setting) ULE, LLE, respiratory muscle training (Tai chi Qigong + exercise)

Chan 2011 *(Continued)*

	Duration: completed 60 minutes twice a week for 3 months
	Usual care: instructed to maintain usual activities
Outcomes	**Assessment:** baseline and 3 months
	Spirometry results, 6MWD, SGRQ, multi-dimensional scale of perceived social support (MSPSS)
	Secondary outcomes
	Number of exacerbations, hospital admissions, Borg scale, SaO_2
Notes	TCQ group not included in the analysis

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Random allocation was done using a randomizer software" (pg 5)
Allocation concealment (selection bias)	Unclear risk	Not informed
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, unable to blind participants and those delivering the intervention
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"Research assistants (RAs) for data collection were blind to the study in order to minimize researcher bias" (pg 6)
Incomplete outcome data (attrition bias) All outcomes	High risk	Commenced: 206; completed: 158 (76.7%); attrition: 48 (23.3%)
Selective reporting (reporting bias)	Low risk	All outcomes were reported between Chan 2010 and Chan 2011 articles and protocol paper
Other bias	Low risk	None noted

Chlumsky 2001

Methods	**Study design:** RCT into 2 groups
Participants	**Setting:** out-patient
	Inclusion criteria:
	• Moderate to severe COPD
	Exclusion criteria:
	Participant status:
	Age (years ± SD): RG: 63 ±11 ; CG: 65 ±13
	Gender (M/F): RG: 12/1; CG: 5/1

Chlumsky 2001 *(Continued)*

	FEV_1 % (pred ± SD): RG: 43% ±21; CG: 51% ±17 **Participants randomly assigned:** Randomised: 19 Analysed: Rehab: 13 Control: 6
Interventions	**Pulmonary rehabilitation:** outpatient hospital LLE, BE Duration: 8 weeks (60 minutes a week) **Usual care:** conventional care
Outcomes	**Assessment:** baseline and 8 weeks ICET, SGRQ, 6MWT
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Randomized using specific PC program taking into consideration severity of bronchial obstruction and aimed at desired ratio 2:1" (letter from study author)
Allocation concealment (selection bias)	Unclear risk	No information provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	Both participants and those delivering the intervention had to be aware of those who were in the intervention group
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	No information provided in relation to attrition, and no indication in results that any participants did not complete the second assessment
Selective reporting (reporting bias)	Low risk	No trial registration protocol was found at http://www.controlled-trials.com/mrct/ or www.who.int/trialsearch (searched for author names and parts of title of paper or intervention)
Other bias	Low risk	None noted

Clark 1996

Methods	**Study design:** RCT

Clark 1996 *(Continued)*

Participants	**Setting:** hospital in Glasgow recruited from a hospital chest clinic; recruited for home-based exercise **Inclusion criteria:** • COPD as defined by the American Thoracic Society • Minimum treatment consisted of inhaled bronchodilator and inhaled steroid; maximum treatment included nebulised bronchodilators and long-term oral steroids **Exclusion criteria:** **Participant status:** Age (years± SD): RG: 58 ± 8 ; CG: 55 ± 8 Gender (M/F): N/A FEV_1 ± SD : RG: 1.72 L ± 0.83; CG: 1.44 L ±0.59 **Participants randomly assigned:** Randomised: 48 Analysed: Rehab: 32 Control: 16
Interventions	**Pulmonary rehabilitation:** home exercise LLE, ULE Duration: 12 weeks once a week **Usual care:** Control group asked to continue with their usual daily routine
Outcomes	**Assessment:** baseline and 12 weeks ICET, ITT QoL: not measured
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Information not available "The 48 patients were randomly allocated into training (n=32) or control (n=16) groups, with a 2:1 training versus control ratio" (pg 2591)
Allocation concealment (selection bias)	Unclear risk	Information not available
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants undertaking the exercise had to be aware that they were receiving same
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not mentioned whether assessors were blinded

Clark 1996 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No account provided of any attrition after allocation; difficult to interpret from the graphs and tables how many completed
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None noted

Cochrane 2006

Methods	**Study design:** RCT, randomly assigned to 1 of 4 interventions
Participants	**Setting:** North Tyneside and South Northumberland from primary and secondary care **Inclusion criteria:** • Males and females between the ages of 40 and 85 years (inclusive) • Diagnosis of COPD (FEV_1 < 80% of predicted and FEV_1/FVC ratio < 70%) **Exclusion criteria:** • Uncontrolled angina • Unable to mobilise (because of severe COPD or other disability) • Had previously attended pulmonary rehabilitation • Current exacerbation of COPD (antibiotics and/or steroids in previous 6 weeks) • Other co-morbidities or communication difficulties that prevented rehabilitation **Participant status:** Age (years± SD): 68.9 ± 7.3 across all groups Gender: male 113 (44.1%): combined 32, exercise 32, CBSM 31, cont 18 Female 143 (55.9%): combined 42, exercise 35, CBSM 33, cont 32 FEV_1 % (pred± SD): 52.4% ± 15.7 across all groups **Participants randomly assigned:** Commenced: 256 Group 1: allocated combined: 74 Group 2: allocated exercise: 67 Group 3: allocated CBMS: 65 Group 4: allocated control: 50
Interventions	**Pulmonary rehabilitation:** out-patient programme (hospital-based PR) Aerobic, ULE, LLE, cognitive behavioural self-management **Duration:** 6 weeks (twice weekly, sessions lasting 2 hours) **Usual care:** This group of participants received no intervention, except standard care

Cochrane 2006 *(Continued)*

Outcomes	**Assessment:** baseline and 6 weeks, 6, 12 months CRQ, Short Form-12 (SF-12), Psychological State Hospital Anxiety and Depression Scale, COPD Self-Efficacy Scale (COPD-SES)
Notes	Incomplete results available for analysis of CRQ (reported as medians)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"The random allocation sequence was generated using cards numbered one to four, which were picked at random. Randomisation was stratified according to site and cohort. There were different sequences for each site (Northumberland and North Tyneside) and a new sequence was started for each of the five cohorts" (pg 34)
Allocation concealment (selection bias)	Low risk	Sealed envelopes: "Letters detailing the group the subject had been randomised to and details of the intervention were then placed in envelopes. Only the patient ID number was visible on the outside of the envelopes" (pg 34)
Blinding of participants and personnel (performance bias) All outcomes	High risk	"Study participants and the practitioners running the interventions could not be blinded to which intervention they were receiving" (pg 34)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"However, both the subjects and the researchers were blinded to the results of previous assessments (they were not allowed to see previous answers to questionnaires for example)" (pg 34)
Incomplete outcome data (attrition bias) All outcomes	High risk	Commenced: 256; completed: 46 (57%); attrition: 43%
Selective reporting (reporting bias)	Low risk	Appeared to report what had been identified for reporting
Other bias	Low risk	None reported

Cockcroft 1981

Methods	**Study design:** RCT The first 20 were allocated entirely randomly, and the remaining 19 by a method known as "minimisation," which ensured an even spread of certain variables between groups Randomisation process: sealed envelopes Outcome assessments: blinded
Participants	**Setting:** in-patient graduated exercise **Inclusion criteria:** • Breathless on exertion but no upper limit (FEV_1) for entry into the study **Exclusion criteria:**

Cockcroft 1981 *(Continued)*

- Men over the age of 70 years
- Other disabling conditions such as severe arthritis
- Those who required domiciliary oxygen

Participant status:

Age (years ± SD): RG: 61± 5; CG: 60 ± 5

Gender (M/F): RG: 18/0; CG: 16/0

FEV_1 ± SD: RG: 1.53 L ±0.70; CG: 1.32 L ± 0.44

Participants randomly assigned:

Randomised: 39
Analysed:
Rehab: 18
Control: 16

Interventions	**Pulmonary rehabilitation:** out-patient rehabilitation centre LLE, ULE Duration: 6 weeks **Usual care:** given no special advice to exercise
Outcomes	**Assessment:** baseline and 2, 4 months 12-Minute WT, ITT Interviews, POMS, Eysenck
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation process: sealed envelopes (letter from study author)
Allocation concealment (selection bias)	Low risk	Study investigators unaware as to order of treatment group assignment (Cochrane Grade A)
Blinding of participants and personnel (performance bias) All outcomes	High risk	As participants had to undertake exercise, they were aware of the group allocation
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information on blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Commenced: 39; 3completed: 4; attrition: 12%
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	Gender selection: male only

De Souto Araujo 2012

Methods	**Study design:** RCT; participants were allocated to 3 experimental groups: control group (CG), floor group (FG) and aquatic group (AG) The randomisation process was conducted by a researcher who was not involved in data collection, through the use of opaque envelopes sealed and numbered consecutively in the ratio 1:1:1 and containing study group assignment
Participants	**Setting:** Brazil **Inclusion criteria:** • Diagnosis of moderate to severe COPD • Informed consent • Clinically stable without periods of exacerbation for at least 8 weeks • Non-smokers or ex-smokers for at least 3 months • Free of lung infection • Medical supervision and authorisation **Exclusion criteria:** • Presented with exacerbation of the disease • Neuromuscular, renal and cardiac disease • Uncontrolled hypertension and diabetes mellitus • Did not perform functional tests or did not complete the 24 sessions **Participant status:** Age (years): RG: [FG: 56.9; AG: 62.4]; CG: 71.1 Gender (M/F): RG:[FG: 8/5; AG: 4/4]; CG: 8/3 FEV_1 % (pred± SD): RG:[FG: 39.2 ± 11.4; AG: 43.9 ± 10.3]; CG: 45.1 ± 12.6 **Participants randomly assigned:** 32 participants were randomly assigned Analysed: Floor group (FG): 13 Aquatic group (AG): 8 Control group (CG): 11
Interventions	**Pulmonary rehabilitation:** Low-intensity water and floor exercises on COPD **Duration:** 8 weeks (3 times: Each session lasted 1 hour and 30 minutes) **Usual care**
Outcomes	**Assessment:** baseline and 8 weeks (6MWT), BODE Index, SGRQ
Notes	Combined 2 intervention groups for analysis

De Souto Araujo 2012 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	The randomisation process was conducted by a researcher not involved in data collection (contact with study authors)
Allocation concealment (selection bias)	Low risk	Sealed envelopes (contact with study authors)
Blinding of participants and personnel (performance bias) All outcomes	High risk	Unable to blind participants because of the nature of the condition
Blinding of outcome assessment (detection bias) All outcomes	Low risk	All evaluations (initial and final) were performed by a single investigator, who did not know to which group participants were allocated
Incomplete outcome data (attrition bias) All outcomes	High risk	42 participants randomly assigned; losses: 10 Attrition: 24%
Selective reporting (reporting bias)	Low risk	It was reported that all said they would
Other bias	Low risk	None noted

Deering 2011

Methods	**Study design:** RCT; randomly assigned to 3 groups: controls, PR and acupuncture and PR Randomisation occurred with the use of a random numbers table
Participants	**Setting:** Dublin (identified via referral from the respiratory service) **Inclusion criteria:** • Diagnosis of COPD based on GOLD • Referred by a respiratory consultant·or Outreach Team • MRC score of ≥ 3 • Ability to mobilise independently • Motivated to exercise independently **Exclusion criteria:** • Acute exacerbation within the past 4-6 weeks • Evidence of ischaemic heart disease • Uncontrolled hypertension • Insulin-dependent diabetes mellitus or musculoskeletal/neurological • Inability to exercise independently • Previous attendance at PR programme **Participant status:** Age (years ± SD): RG: [PR only 67.7 ± 5.3, PR + Acu 65.1 ±9.7]; CG: 68.6 ± 5.5

Deering 2011 *(Continued)*

	Gender (M/F): RG: [PR only 11/14, PR + Acu 8/8]; CG: 12/7
	FEV_1 % (pred ± SD): RG: [PR only 77.0 ±19 , PR + Acu 80.7 ± 24.2]; CG: 45.8 ± 1 8.3
	Smokers, packs per year: RG: [PR only 51, PR + Acu 846.5]; CG: 46.2
	Participants randomly assigned:
	60 randomised (control 19, PR 25, 19 PR + Acu)
	Analysed:
	14 control
	11 PR
Interventions	**Pulmonary rehabilitation:** out-patient programme (hospital-based PR)
	Aerobic, ULE, LLE, respiratory muscle training, Edu
	Duration: 7 weeks, 14 PR sessions
	Usual care: no specific intervention
Outcomes	**Assessment:**
	Baseline, end of PR and 3-month follow-up
	St. George's Questionnaire
	Incremental shuttle walk test
	FEV_1, Pi Max
	Feree Living Physical Activity, EQ5D
Notes	Only the PR group was reported on in the analysis

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation occurred with use of a random numbers table
Allocation concealment (selection bias)	Unclear risk	No information available
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, it is not possible to blind participants or those delivering the programme
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessors and the medical team analysing the blood samples were blinded to the treatments received
Incomplete outcome data (attrition bias) All outcomes	High risk	Commenced: 44 in control and PR groups; assessed: 25 Attrition: 19 (42%)

Deering 2011 *(Continued)*

Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Unclear risk	None identified

Elci 2008

Methods	**Study design:** RCT; 2 groups Participants were randomly allocated to control or experimental groups with the use of number tables. Concealed until after allocation; once allocated, both participants and those delivering the intervention were aware of those in the intervention group
Participants	**Setting:** • Secondary care community hospital, Pulmonary Diseases Department, Turkey **Inclusion criteria:** • Diagnosis of COPD • Absence of reversibility residence • Within the Malatya city boundary **Exclusion criteria:** • Diagnosis of other respiratory disease such as tuberculosis or cancer • Inability to understand the pulmonary rehabilitation programme **Participant status:** Age (years ± SD): RG: 59.67 ± 8.6; CG: 58.08 ± 11.45 Gender (M/F): RG: 33/6; CG: 33/6 FEV_1 % (pred): RG: 47.7; CG: 46.28 FEV_1/FVC (± SD): RG: 55.46 ± 8.79; CG: 55.10 ± 7.17 Smokers %: RG: 33.3; CG: 20.5 **Participants randomly assigned:** 78 participants with COPD randomised: Analysed: 39 experimental group 39 control group
Interventions	**Pulmonary rehabilitation:** combined home/community/out-patient **Duration:** 3 months; exercises twice a day for 10 minutes, 5 days a week, at home under the supervision of a relative All participants performed 24 sessions Aoribic, ULE, LLE, Edu

Elci 2008 *(Continued)*

	Usual care: Control group received standard medical care
Outcomes	**Assessment:** baseline,1 month, 3 months St. George's Questionnaire SF-36, HADS Hospital Anxiety and Depression, 6MWT, MMRC
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomly allocated to control or experimental groups with the use of number tables
Allocation concealment (selection bias)	Unclear risk	No information provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, participants had to be aware of their allocation
Blinding of outcome assessment (detection bias) All outcomes	Low risk	However, the nurse was blinded to the results of the SF-36, SGRQ, HADS and MMRC
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No account of attrition provided
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	High risk	Gender imbalance noted

Emery 1998

Methods	**Study design:** RCT (3 groups: exercise, education and stress management (EXESM); education and stress management (control) Randomisation process: random numbers table Outcome assessments: blinded
Participants	**Setting:** out-patient **Inclusion criteria:** • Stable COPD age > 50 years • Airflow obstruction demonstrated on spirometry • Clinical symptoms of COPD for longer than 6 months **Exclusion criteria:**

Emery 1998 *(Continued)*

- Significant cardiac disease or other diseases that might affect exercise tolerance or learning skills
- Acute, reversible airway disease (asthma) without fixed airflow obstruction
- Significant disabling disease such as tuberculosis, pulmonary
- Fibrosis or cancer; unstable cardiac disorder during the previous 3 months
- Medical conditions that limit participation in a regular exercise programme

Participant status:

Age (years ± SD): RG: 65 ± 6; CG: 67 ± 7

Gender (M/F): RG: 15:15; CG: 12/13

FEV_1 (±SD): RG: 1.29 L ± 0.63; CG: 1.02 L ± 0.37

Participants randomly assigned:

Randomised: 79
Analysed:
Rehab: 25
Control: 25

Interventions	**Pulmonary rehabilitation:** 3 groups: floor group (FG), aquatic group (AG) and control group (out-patient) LLE, ULE, Edu, Psy **Duration:** 10 weeks (for 4 hours per day) **Usual care:** asked not to alter activities significantly during the 10-week study
Outcomes	**Assessment:** baseline and after the 10-week intervention period ICET, SIP
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	From a random number schedule, printed on a piece of paper
Allocation concealment (selection bias)	Low risk	Study investigators unaware as to order of treatment group assignment (Cochrane Grade A)
Blinding of participants and personnel (performance bias) All outcomes	High risk	Concealed until after allocation; once allocated, both participants and those delivering the intervention were aware of those in the intervention group
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Technical staff conducting the assessments were not aware of group assignments
Incomplete outcome data (attrition bias) All outcomes	Low risk	Overall loss: 6 Attrition: 7.6%
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported

Emery 1998 *(Continued)*

Other bias	Low risk	None noted

Engström 1999

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** out-patients and home patients recruited from Pulmonary Medicine Department in Goteborg, Sweden **Inclusion criteria:** • Diagnosis of COPD • Age 47-75 years • FEV_1 < 50% (pred) after bronchodilator paO_2 of 8 kPa and stable condition **Exclusion criteria:** • Disabling or severe disease other than COPD or the co-existence of other causes of impaired pulmonary function **Participant status:** Age (years ± SD): RG: 66 ± 5; CG: 67 ± 5 Gender (M/F): RG: 14/12; CG: 12/12 FEV_1 % (pred): RG: 30.7; CG: 34.1 Smokers: RG: 6; CG: 4 **Participants randomly assigned:** Randomised: 55 Analysed: Rehab: 26 Control: 24
Interventions	**Pulmonary rehabilitation:** out-patient and home based LLE, ULE, Edu, IMT Duration: 52 weeks (training at the physio department twice weekly for 6 weeks followed by once weekly for 6 weeks and every second week for 6 weeks, then monthly for the remainder of the year. Each session lasted 45 minutes **Usual care:** Control received usual out-patient care
Outcomes	**Assessment:** baseline to 12 months 6-Minute WT, ICET SIP, SGRQ
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement

Engström 1999 *(Continued)*

Random sequence generation (selection bias)	Low risk	Computer random number tables
Allocation concealment (selection bias)	Low risk	Study investigators unaware as to order of treatment group assignment (Cochrane Grade A)
Blinding of participants and personnel (performance bias) All outcomes	High risk	Those receiving the programme had to be aware that they were receiving the intervention
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessments: blinded for HRQoL, not blinded for WT
Incomplete outcome data (attrition bias) All outcomes	Low risk	50 out of 55 completed (90.9%) Attrition rate: 9.1%
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None identified

Faager 2004

Methods	**Study design:** RCT (2 groups); 2 weeks after onset of oxygen therapy, 20 participants were randomly assigned to rehabilitation
Participants	**Setting:** in-patient/home Department of Pulmonary Medicine of the Karolinska Hospital: over 2 years **Inclusion criteria:** • Diagnosis of COPD • Established need for LTOT • Ability to move about with or without a walking frame • Willingness to participate in the study **Exclusion criteria:** • Symptomatic cardiac disease or neurological or orthopaedic mobility impairment **Participant status:** Age (years ± SD): RG: 72 ± 9; CG: 70 ± 8 Gender (M/F): RG: 3/7; CG: 3/7 FEV_1 % (pred ± SD): RG: 26 ± 7 ; CG: 28 ± 6 **Participants randomly assigned:** Randomised: 20 (RG: 10; CG: 10) Analysed: Rehab: 7 Control: 7
Interventions	**Pulmonary rehabilitation:** in-patient and home based

Faager 2004 *(Continued)*

	Aerobic, ULE, LLE, Edu **Duration:** 8-Week programme with 1 training session a week; training took 90 to 120 minutes **Usual care**
Outcomes	**Assessment:** baseline and 8 weeks, 6 months CRQ, 6-Minute WT, spirometry, blood gas analyses, pulse oximetry, Hospital Anxiety and Depression Scale (HADS) Stanford Health
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No clear statement on random sequence generation
Allocation concealment (selection bias)	Unclear risk	No detail re allocation concealment or how randomisation was done
Blinding of participants and personnel (performance bias) All outcomes	High risk	Both participants and those delivering the programme were aware of those included in the intervention group
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	High risk	Commenced overall: 20; finished week 8: 14 Attrition: 30%
Selective reporting (reporting bias)	Low risk	No protocol paper was registered, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None noted

Faulkner 2010

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** recruited from primary care; 16 GP practices in Exeter **Inclusion criteria:** • Clinical diagnosis of COPD, FEV_1/forced vital capacity (FVC) ratio ≤ 70% • Smoking history > 10 pack-years • Symptoms considered to be inadequately controlled by short-acting bronchodilators • Willing and able to undertake a HEPA programme **Exclusion criteria:** • Body mass index (BMI) > 35 kg/m^2

Faulkner 2010 *(Continued)*

- Recent respiratory tract infection
- Oxygen desaturation (SaO_2) at rest < 90%
- Prior participation in a PR programme
- Serious co-morbid condition that would interfere with regular exercise training

Participant status:

Age: not provided

Gender (M/F): not provided

FEV_1 % (pred): not provided

Smokers: all current non-smokers

Participants randomly assigned:

Randomised: 20 (RG: 10; CG: 10)
Analysed:
Rehab:6
Control:8

Interventions	**Pulmonary rehabilitation:** community (primary care setting) Exercise programme run in an exercise facility at a university Aerobic, ULE, LLE, Edu **Duration:** 8 weeks once-weekly 90-minute supervised exercise and education sessions delivered by a qualified exercise and healthcare practitioner **Usual care:** Control group received usual care. All were given tiotropium
Outcomes	**Assessment:** baseline, 1 week post intervention CRQ, ISWT, lung information needs questionnaire (LINQ), HADS, 7-day physical activity recall questionnaire, physical self-perception profile (PSPP)
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation sequence, stratified for smoking status, computer generated by a statistician who was independent of the trial
Allocation concealment (selection bias)	Low risk	Group allocation was kept concealed by means of sealed envelopes, which were opened in sequence by the trial researcher following baseline assessment
Blinding of participants and personnel (performance bias) All outcomes	High risk	It was not possible to blind participants or GPs to group allocation
Blinding of outcome assessment (detection bias)	High risk	Outcome assessors not blinded

Faulkner 2010 *(Continued)*

All outcomes		
Incomplete outcome data (attrition bias) All outcomes	High risk	20 randomly assigned; attrition: overall 6 (30%)
Selective reporting (reporting bias)	Low risk	All outcomes listed in the paper appear to have been reported
Other bias	Low risk	None noted

Fernandez 2009

Methods	**Study design:** RCT (2 groups) performed in a 300-bed district hospital and involving patients with very severe COPD who received oxygen treatment
Participants	**Setting:** Spanish study; 300-bed district hospital **Inclusion criteria:** • Diagnosis of very severe COPD • Younger than 80 years of age • Stable COPD (2 months with no exacerbations) • Correct administration of pharmacological treatment • Home treatment with oxygen for at least 6 months **Exclusion criteria:** • Severe cardiovascular pathology, unstable angina or acute myocardial infarction, cerebrovascular accident • Physical or psychological disorder that impedes the practice of physical exercise **Participant status:** Age (years ± SD): RG: 66 ± 8; CG: 70 ± 5 Gender (M/F): 1 woman, as the rest were men FEV_1 % (pred ± SD): RG: 33 ± 10; CG: 38 ± 12 FEV_1/FVC (± SD): RG: 42 ± 10; CG: 42 ± 11 **Participants randomly assigned:** Randomised: 50 (RG: 30; CG: 20) Analysed: Rehab:27 Control:14
Interventions	**Pulmonary rehabilitation:** home based Aerobic exercise, ULE, LLE, educational material, home physio visits **Duration:** received 2 one-hour sessions in the hospital. A minimum of 1 hour of exercise per day was indicated, for a minimum of 5 days per week **Usual care**
Outcomes	**Assessment:** baseline and Imediately post intervention (1 year)

Fernandez 2009 *(Continued)*

	6MWT, SGRQ
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not informed of process: only "randomly divided into 2 groups"
Allocation concealment (selection bias)	Unclear risk	Not informed
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, unable to blind participants or those delivering the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not informed
Incomplete outcome data (attrition bias) All outcomes	Low risk	After 1 year, 41 participants completed (83.7%) Attrition: 16.3%
Selective reporting (reporting bias)	Low risk	No protocol paper was found, but all outcomes listed in the paper appear to have been reported
Other bias	High risk	All men; 1 woman excluded from analysis

Finnerty 2001

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** recruited from an out-patient clinical at the Chester Hospital NHS Trust, UK **Inclusion criteria:** • Long-standing airways disease, classified as COPD • Had therapy optimised • Given up smoking or prepared to make an active effort to stop smoking during the proposed programme **Exclusion criteria:** • Dementia or marked agitation or depression evident to investigators • Unstable medical condition, such as congestive cardiac failure, cor pulmonale, malignancy or cerebrovascular accident • Previously participated in a supervised respiratory rehabilitation programme **Participant status:** Age (years ± Sd): RG: 70.4 ± 8.0; CG: 68.4 ± 10.4 Gender (M/F): RG: 25/11; CG: 19/10

Finnerty 2001 *(Continued)*

	FEV_1 % (pred ± SD): RG: 41.2 ± 19.2; CG: 41.2 ± 16.2 Smoking NO: RG: 2; CG: 6 **Participants randomly assigned:** Randomised: 100 (27 did not attend initial assessment) Analysed: Rehab:36 Control: 29
Interventions	**Pulmonary rehabilitation:** 6-Week out-patient-based rehabilitation programme ULE, LLE, Edu **Duration:** 6-Week out-patient-based rehabilitation programme; 2 visits per week: 2-hour education visit and 1-hour exercise visit **Usual care:** Control group reviewed routinely as medical out-patients
Outcomes	**Assessment:** baseline, 12 weeks and 24 weeks 6-Minute WT, SGRQ
Notes	Jadad's score = 3

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was in blocks of 10, using random numbers
Allocation concealment (selection bias)	Low risk	Study investigators unaware as to order of treatment group assignment (Cochrane Grade A)
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the exercise programme, unable to blind allocation
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"Both tests were supervised by a blinded observer who subsequently repeated these assessments"
Incomplete outcome data (attrition bias) All outcomes	High risk	100 randomly assigned; 55 completed (55%) Only 73 attended for initial assessment 45% attrition
Selective reporting (reporting bias)	Low risk	No protocol paper was found, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None identified

Gohl 2006

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** out-patient community, training in sports hall; Germany **Inclusion criteria:** • Included participants suffered from medium to severe COPD • 50 to 75 years old **Exclusion criteria:** • Decompensated coronary heart disease, haemodynamically efficient cardiac arrhythmia or "Kartiti-den," insufficiently adjusted arterial hypertension, global respiratory insufficiency, significant partial respiratory insufficiency (paO_2 < 50 mmHg and/or SaO_2 > 80% at rest), right heart overload due to pulmonary hypertension at rest (accelerative time > 100 m/s) • Positive bronchodilation test showing an increase in FEV_1 > 15% exacerbated COPD • Severe obesity (BMI > 35) • Limited capacity on the bicycle ergometer **Participant status:** Age (years ± SD): RG: 62.5 ± 7; CG: 63.2 ± 8.5 Gender (M/F): RG: 6/4; CG: 7/2 FEV_1 % (pred ± SD): RG: 53.4 ± 10.7; CG: 53.7 ± 5.8 **Participants randomly assigned:** Randomised: 34 (RG: 17; CG 17) Analysed: Rehab:10 Control: 9
Interventions	**Pulmonary rehabilitation:** community, complex long-term training programme Aerobic exercise, ULE, LLE (escalating levels of activity over time) **Duration:** 12-month training programme **Usual care:** Control group did not receive therapy
Outcomes	**Assessment:** Baseline and 12 months (end of intervention) 6MWT, St. George's Questionnaire, SF-36, muscle force
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Assigned to training group or control group at random (chosen by lot)
Allocation concealment (selection bias)	Unclear risk	Not provided

Gohl 2006 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, it is not possible to blind participants or those delivering the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not provided
Incomplete outcome data (attrition bias) All outcomes	High risk	Commenced: 34; completed: 19; lost: 15 Attrition: 44%
Selective reporting (reporting bias)	Low risk	No protocol paper was found, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None noted

Goldstein 1994

Methods	**Study design:** RCT (2 groups) Randomisation process: random numbers table Outcome assessments: blinded
Participants	**Setting:** in-patient/out-patient; Canada **Inclusion criteria:** • Severe stable COPD (forced expiratory volume in 1 second (FEV_1) < 40% predicted; FEV/forced vital capacity (FVC) < 0-7) • Non-smoker for a minimum of 2 months • Dyspnoea in 3 or more activities of daily living • Ability to communicate in English. **Exclusion criteria:** • Participated in a supervised respiratory rehabilitation programme within the previous 2 years • Associated medical conditions that might limit exercise tolerance or cognitive functioning **Participant status:** Age (years ± SD): RG: 66 ± 7; CG: 65 ± 8 Gender (M/F): RG: 21/17; CG: 17/23 FEV_1 % (pred ± SD): RG: 34.8 ±14.5; CG: 34.6 ± 11.8 FEV_1 /FVC: RG: 36.8 ± 9.5; CG: 38.8 ± 12.4 Smoking packs (± SD): RG: 58 ± 24; CG: 51 ± 26 per year **Participants randomly assigned:** Randomised: 89 Analysed: Rehab: 38

Goldstein 1994 *(Continued)*

	Control: 40
Interventions	**Pulmonary rehabilitation:** in-patient/home based Aerobics, LLE, ULE, BE, Edu, Psy **Duration:** 2 months of in-patient rehabilitation followed by 4 months of out-patient care **Usual care:** Control group received conventional care from general practitioner and respiratory specialist
Outcomes	**Assessment:** baseline and 24 weeks 6-Minute WT, ICET, SSCET, CRQ, BDI/TDI
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Used random tables for allocation
Allocation concealment (selection bias)	Low risk	Study investigators unaware as to order of treatment group assignment (Cochrane Grade A)
Blinding of participants and personnel (performance bias) All outcomes	High risk	Both participants and those delivering the intervention were aware of the allocation of participants
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Investigator carrying out outcome assessments blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	89 randomised and 78 completed Attrition: 11 (12%)
Selective reporting (reporting bias)	Low risk	No protocol paper was found, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None noted

Gomez 2006

Methods	**Study design:** RCT (3 groups); PR for 3 months and rehabilitation maintenance for 12 months (RHBM group). Second group received PR for 3 months only (RHB group) and the third was the control
Participants	**Setting:** recruited by family physicians from 7 primary care practices in Palma de Mallorca, Spain **Inclusion criteria:** • 35 to 74 years old

Gomez 2006 *(Continued)*

- Moderate COPD according to GOLD criteria
- Postbronchodilator results of $FEV_1/FVC < 0.7$, FEV_1 values between 50% and 80%
- Smokers or non-smokers

Exclusion criteria:

- Any musculoskeletal condition that prevented exercising and walking test assessments
- Terminal illness or other severe disease at the time of enrolment

Participant status:

Age (years): RG (RHB: 64.1; RHBM: 64.9); CG: 63.4

Gender (M/F): RG: 39/9; CG: 19/4

FEV_1 % (pred): RG: 74 (Range 66.5-81.5); CG: 60.1 (Range 55.6-64.4)

FEV_1/FVC: RG: 61.2; CG: 59.1

Participants randomly assigned:

Randomised: 97 (33 RHB group and 32 RHBM; control 32)
Analysed:
Rehab:36
Control: 14

Interventions	**Pulmonary rehabilitation:** community (primary care setting) Aerobic exercise, ULE, LLE, educational material **Duration:** 3 months; rehabilitation maintenance for 12 months **Usual care:** Group received routine care without rehabilitation
Outcomes	**Assessment:** Baseline, 3 months and 12 months CRQ, pulmonary function tests, 6MWT
Notes	Analyses completed on 3-month results for combined RHB and RHBM groups

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Centrally administered, computer-generated block randomisation scheme using blocks of 6 with EPIDAT, stratified according to participating site
Allocation concealment (selection bias)	Low risk	See above
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, unable to blind participants and those delivering the intervention
Blinding of outcome assessment (detection bias)	Low risk	Health staff members involved in follow-up (a psychologist and a nurse) were blinded to participant assignment

Gomez 2006 *(Continued)*
All outcomes

Incomplete outcome data (attrition bias) All outcomes	High risk	Out of 97, only 50 at 3-month evaluation Attrition: 47 (48%)
Selective reporting (reporting bias)	Low risk	Trial registration (ISRCTN94514482); all outcomes stated in the study appear to have been measured
Other bias	Low risk	None noted

Gosselink 2000

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** out-patient: referred from an outpatient department in Leuven, Belgium **Inclusion criteria:** • Younger than 75 years of age; forced expiratory volume in 1 second (FEV_1) less than 65% of predicted value • Stable clinical condition at inclusion **Exclusion criteria:** • Infection or COPD exacerbation in the previous 4 weeks • Severe medical problems, such as heart failure, myocardial infarction, cerebrovascular disease, cancer or orthopaedic disorders **Participant status:** Age (years ± SD): RG: 60 ± 9; CG: 63 ± 7 Gender (M/F): RG: 31/6; CG: 30/3 FEV_1 % (pred ± SD): 41 ±16; RG: CG: 43 ±12 **Participants randomly assigned:** Randomised: 100 Analysed: Rehab: 34 Control: 28
Interventions	**Pulmonary rehabilitation:** outpatient sessions; cycling, treadmill walking, stair climbing and peripheral muscle training LLE, ULE **Duration:** 24 weeks: 3 times a week in the first 3 months; during subsequent 3 months, training frequency was reduced to twice weekly. Each session had a duration of 1.5 hours **Usual care:** usual medical care
Outcomes	**Assessment:** baseline and at 6 months and 18 months 6-Minute WT, ICET, CRQ Isometric quadriceps strength, inspiratory and expiratory muscle strength

Gosselink 2000 *(Continued)*

Notes

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation process: sealed envelopes
Allocation concealment (selection bias)	Low risk	Study investigators unaware as to order of treatment group assignment (Cochrane Grade A)
Blinding of participants and personnel (performance bias) All outcomes	High risk	Both participants and those delivering the intervention were aware of the allocation of participants
Blinding of outcome assessment (detection bias) All outcomes	High risk	Outcome assessments: not blinded
Incomplete outcome data (attrition bias) All outcomes	High risk	Commenced: 100; 6 months: 62; remaining: 62% Attrition: 38%
Selective reporting (reporting bias)	Low risk	No protocol paper was found, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None noted

Gottlieb 2011

Methods

Study design: RCT (2 groups)

Single-centre, randomised, placebo-controlled, unblinded clinical trial

Participants

Setting: patients listed with 56 GPs in Copenhagen, Denmark

Inclusion criteria:

- Diagnosis of moderate COPD
- Motivation for pulmonary rehabilitation

Exclusion criteria:

- Co-morbidity contraindicating rehabilitation
- Participation in pulmonary rehabilitation within the past year
- Cognitive disorders limiting ability to participate in physical training and educational sessions

Participant status:

Age (years, Range): RG: 74.1 (66–82); CG: 73.2 (67–88)

Gender (M/F): RG: 7/15; CG: 7/13

FEV_1 % (pred ± SD): RG: 64.27 ± 7.9; CG: 67.05 ± 8.8

FEV_1 /FVC (± SD): RG: 0.54 ± 0.07; CG: 0.6 ± 0.1

Gottlieb 2011 *(Continued)*

	Smokers: RG: 11; CG: 9 **Participants randomly assigned:** Randomised: 61 (RG: 35; GG: 26) Analysed: Rehab: 22 Control: 20
Interventions	**Pulmonary rehabilitation:** community Aerobic exercise, ULE, LLE, Edu, follow-up call **Duration:** 7 weeks; two 90-minute sessions a week **Usual care:** standard COPD care received from GP
Outcomes	**Assessment:** baseline and 6 months 6MWT, MRC, SGRQ
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was performed using sealed opaque envelopes randomly assigned to participants
Allocation concealment (selection bias)	Low risk	
Blinding of participants and personnel (performance bias) All outcomes	High risk	Both participants and those delivering the intervention were aware of the allocation of participants
Blinding of outcome assessment (detection bias) All outcomes	High risk	Unblinded clinical trial
Incomplete outcome data (attrition bias) All outcomes	High risk	61 randomly assigned, 42 completed (68%) Attrition: 32%
Selective reporting (reporting bias)	Low risk	Study authors appear to have reported what they said they would at the beginning of the article
Other bias	Low risk	None identified

Griffiths 2000

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** recruited from local hospitals and local general practices to participate; Wales

Griffiths 2000 *(Continued)*

	Out-patient + Home-based follow-up **Inclusion criteria:** • FEV_1 < 60% of predicted with < 20% reversibility • No change in symptoms or medication for 2 months **Exclusion criteria:** • Could not walk • Severe sensory or cognitive impairment or symptomatic ischaemic heart disease **Participant status:** Age (years ± SD): RG: 68.2 ± 8.2; CG: 68.3 ± 8.1 Gender (M/F): RG: 57/36; CG: 54/37 FEV_1 % (pred ± SD): RG: 39.7 ±16.2; CG: 39.4 ±16.4 FEV_1 /FVC (± SD): RG: 0.49 ± 0.13; CG: 0.49 ± 0.13 Smoking, packs per year: RG: 43.5 (31.1); CG: 45.7 (21.9) **Participants randomly assigned:** Randomised: 200 Analysed: Rehab: 93 Control: 91
Interventions	**Pulmonary rehabilitation:** multi-disciplinary, out-patient/home based LLE, ULE, Edu, Psy, NS, SmC **Duration:** 6 weeks, 3 half-days per week; session 2 hours long; in addition encouraged to follow a home exercise routine **Usual care:** continued with usual out-patient or primary care follow-up
Outcomes	**Assessment:** baseline and follow-up for 1 year Shuttle WT, CRQ, SF-36, SGRQ, HADS
Notes	Jadad's score = 2

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation process: sealed envelopes
Allocation concealment (selection bias)	Low risk	Study investigators unaware as to order of treatment group assignment (Cochrane Grade A)
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, it is not possible to blind participants or those delivering the intervention

Griffiths 2000 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessments: blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	200 commenced; 180 completed Attrition: 10%
Selective reporting (reporting bias)	Low risk	No protocol paper was found, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None noted

Gurgun 2013

Methods	**Study design:** RCT (3 groups)

Participants	**Setting:** patients from Ege University Hospital Turkey outpatient clinic admitted to the PR unit between January 2010 and November 2010
	Inclusion criteria:
	• Diagnosis of COPD
	• Evidence of nutritional depletion defined as meeting at least 1 of the following criteria (10):
	  • Body mass index (BMI/height squared) ≤ 21 kg/m^2, Fat Free Mass Index (FFM/height squared) ≤ 15 kg/m^2 for women or 16 kg/m^2 for men; or
	  • BMI ≤ 25 kg/m^2 plus weight loss of at least 5% in 1 month, or at least 10% in 6 months, before admission
	Exclusion criteria:
	• Disabling conditions (neuromuscular, malignant disorders, unstable cardiovascular disease, orthopaedic problems, severe pulmonary hypertension)
	• Unwilling to complete the programme
	• Suffering from acute exacerbation over the previous 4 weeks
	• Lack of motivation or poor compliance
	Participant status:
	Age (years ± SD): RG: [PRNS: 64.0 ± 10.8; PR: 66.8 ± 9.6]; CG: 67.8 ± 6.6
	Gender (M/F): RG: [PRNS 13/2; PR: 15/0]; CG: 16/0
	FEV_1 % (pred ± SD): RG:[PRNS: 41.9 ± 10.8; PR: 41.9 ± 13.2]; CG: 39.3 ± 9.3
	FEV_1 /FVC (± SD): RG: [PRNS: 53.4 ± 15.8; PR: 49.0 ± 6.7]; CG: 46.7 ± 7.2
	Participants randomly assigned:
	Randomised: 46
	Analysed:
	Rehab: PRNS: 15; PR: 15
	Control: 16

Interventions	**Pulmonary rehabilitation:** out-patient programme (hospital based). Pulmonary rehabilitation and nutritional support (Pr Alone (PR) or PR and nutritional support (PRNS)) Aerobic exercise, ULE, LLE, educational material, nutritional support

Gurgun 2013 *(Continued)*

	Duration: 8 weeks **Usual care:** usual medical standard care
Outcomes	**Assessment:** baseline and following 8 weeks of PR MRC, 6MWT, ISWT, ESWT, SGRQ, HADS
Notes	Reported results using combined group PR + PRNS

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Eligible patients were randomly assigned in a 1:1:1 ratio with the use of sealed envelopes
Allocation concealment (selection bias)	Low risk	As above
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, unable to blind participants or those delivering the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not stated
Incomplete outcome data (attrition bias) All outcomes	Low risk	No attrition reported
Selective reporting (reporting bias)	Low risk	No protocol paper was found, but all outcomes listed in the paper appear to have been reported
Other bias	High risk	All men; 15 in PR group, 15 in control. 2 women in PRNS

Güell 1995

Methods	**Study design:** RCT (2 groups) **Randomisation process:** random numbers table **Outcome assessments:** blinded
Participants	**Setting:** out-patient: secondary care respiratory clinic in Barcelona **Inclusion criteria:** • Participants older than 75 years • FEV_1 70% of reference values, FEV_1/FVC 65%, PaO_2 55 mmHg at rest • No indication for prescribing home oxygen therapy **Exclusion criteria:** • Experienced an exacerbation or hospitalised in the previous month • Clinically apparent heart disease or relevant bone or joint disease

Güell 1995 *(Continued)*

	Participant status: Age (years): RG: 66 (7); CG: 65 (6) Gender (M/F): all men FEV_1 % (pred): RG: 31 (12); CG: 39 (14) **Participants randomly assigned:** Randomised: 60 Analysed: Rehab: 29 Control: 27
Interventions	**Pulmonary rehabilitation** (out-patient and home based; 3 months of outpatient breathing retraining and chest physiotherapy; 3 months of daily supervised exercise) LLE, BE, PD **Duration:** 6 months (3 months of PR; participants were included in two 30-minute sessions each week (breathing retraining) combined with home exercise programme). Second 3-month period (exercise training): five 30-minute sessions weekly on a stationary cycle ergometer **Usual care:** Control group received standard care
Outcomes	**Assessment:** baseline and 3, 6, 9, 12, 18 and 24 months 6MWT, ICET, CRQ
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Used random number tables; letter sent to LaCasse
Allocation concealment (selection bias)	High risk	No concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Unable to blind both participants and those delivering the intervention because of the nature of the intervention
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Technicians who collected data for outcome measures at every visit, as explained below, were blinded to participants' allocation to PR or control groups
Incomplete outcome data (attrition bias) All outcomes	Low risk	All 60 participants completed 6 months of follow-up
Selective reporting (reporting bias)	Low risk	No protocol paper was found, but all outcomes listed in the paper appear to have been reported
Other bias	High risk	All men only

Güell 1998

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** out-patient **Inclusion criteria:** • Age ≤ 75 years; FEV_1 < 70% of reference values; FEV_1/FVC ratio < 65%; Pao_2 > 55 mmHg at rest • No indications for home oxygen therapy • No exacerbation or hospitalisation in the previous 2 months **Exclusion criteria:** • Psychiatric disturbance • Heart disease • Relevant bone or joint disease **Participant status:** Age (years ± SD): 68 ± 8; CG: 66 ± 8 Gender (M/F): RG: 16/2; CG: 17/0 FEV_1 % (pred ± SD): RG: 32% ±11; CG: 38% ±15 **Participants randomly assigned:** Randomised: 40 Analysed: Rehab: 18 Control: 17
Interventions	**Pulmonary rehabilitation:** 2 months of chest physio and 2 months of muscle training LLE, IMT Duration: 8 weeks **Usual care**
Outcomes	**Assessment:** baseline and post intervention (8 weeks) CRQ, 6MWT, dyspnoea, maximal workload
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random numbers table
Allocation concealment (selection bias)	High risk	Randomisation was not concealed, but the likelihood of bias introduced by unconcealed randomisation was reduced by recruitment of consecutive patients
Blinding of participants and personnel (performance bias)	High risk	Unable to blind both participants and those delivering the intervention because of the nature of the intervention

Güell 1998 *(Continued)*

All outcomes		
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Technicians who collected data were blinded to participant allocation to the PRG or the CG, as were data analysts, until the analysis was deemed complete
Incomplete outcome data (attrition bias) All outcomes	Low risk	Commenced: 40; attrition: 5 (12%)
Selective reporting (reporting bias)	Low risk	No protocol paper was found, but all outcomes listed in the paper appear to have been reported
Other bias	Low risk	None noted

Hernandez 2000

Methods	**Study design:** RCT (2 groups) Randomisation process: random numbers table Outcome assessments: blinded
Participants	**Setting:** home-based; Seville, Spain **Inclusion criteria:** • COPD diagnosed in accordance with European Respiratory Society Consensus Statement • Stable phase of disease with optimal drug management **Exclusion criteria:** • Evidence of ischaemic heart disease, severe or uncontrolled systemic arterial hypertension, alterations in the thoracic cage • Neuromuscular disorders or intermittent claudication or osteoarticular lesions in the lower extremity that could affect normal ambulation • Acute exacerbation in the course of the programme excluded **Participant status:** Age (years ± SD): RG: 64.3 ± 8.3 ; CG: 63.1 ± 6.9 Gender (M/F): RG: 20/0; CG: 17/0 FEV_1 % (pred ± SD): RG: 71.1 ± 18.9; CG: 74.7 ± 14.7 FEV_1 /FVC (SD): RG: 47 ± 9.9; CG: 42.3 ±12 **Participants randomly assigned:** Randomised: 60 Analysed: Rehab: 20 Control: 17
Interventions	**Pulmonary rehabilitation:** home rehabilitation programme; training intensity was determined individually LLE **Duration:** 12 weeks

Hernandez 2000 *(Continued)*

	Usual care: Control group participants (standard medical treatment alone; also made visits to the hospital every 2 weeks for a clinical checkup and for supervision of treatment)
Outcomes	**Assessment:** baseline and 12 weeks ICET, Shuttle WT, CRQ, BDI/TDI
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random numbers table used
Allocation concealment (selection bias)	Unclear risk	No details provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	Unable to blind both participants and those delivering the intervention because of the nature of the intervention
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Investigators were blinded (letter from study author)
Incomplete outcome data (attrition bias) All outcomes	High risk	60 randomly assigned; 37 completed (61.6%) Attrition: 38.3%
Selective reporting (reporting bias)	Low risk	It appears that all outcomes stated at the outset of the article were reported in the findings
Other bias	Low risk	Participants who were excluded because they did not meet the criteria appear to have been excluded after randomisation

Hoff 2007

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** Norway **Inclusion criteria:** • Clinical definition of COPD with FEV_1/FVC < 70% and FEV_1 < 60% predicted • Between 40 and 70 years of age **Exclusion criteria:** • History of cardiovascular disease, lung disease other than COPD, diabetes mellitus or other metabolic diseases, malignant disease, pregnancy • Corticosteroid use in the past 6 months • Respiratory tract infection within the past 4 weeks **Participant status:**

Hoff 2007 *(Continued)*

	Age (years ± SD): RG: 62.8 ± 1.4; CG: 60.6 ± 3.0 Gender (M/F): RG: 4/2; CG: 4/2 FEV_1/FVC (± SD): RG: 49.9 ± 4.6; CG: 45.2 ± 6.0 **Participants randomly assigned:** Randomised: Analysed: 12 Rehab: 6 Control: 6
Interventions	**Pulmonary rehabilitation:** lab-based maximal strength training (seated horizontal leg press apparatus) LLE **Duration:** 8 weeks **Usual care:** Control group continued normal daily living with modest regular activity, as recommended by pulmonary physician
Outcomes	**Assessment:** baseline and week 8 Incremental cycle ergometry
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information provided
Allocation concealment (selection bias)	Unclear risk	Insufficient information provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, unable to blind both participants and those delivering the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Insufficient information provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants completed the study protocol with no adverse effects, and the MST group completed 100% of the planned training
Selective reporting (reporting bias)	Low risk	No protocol was identified. All outcomes identified in the methods section of the paper were reported in the results
Other bias	Low risk	None noted

Jones 1985

Methods	**Study design:** RCT (3 groups: exercise, resistive breathing, control)
Participants	**Setting:** home based; recruited from a chest clinic in Dunedin, New Zealand **Inclusion criteria:** • Fewer than 75 regular attendees at clinics • Severe irreversible airflow obstruction; FEV_1 < 1.2 and < 20% improvement after bronchodilator **Exclusion criteria:** • Angina pectoris, left and right heart failure, neuromuscular or skeletal disease that limited exercise **Participant status:** Age (years ± SD): RG: 63.8 ± 6.09; CG: 62.7 ± 8.36 Gender (M/F): RG: 6/2; CG: 1/5 FEV_1 % (pred ± SD): RG: 0.78 ± 0.27; CG: 0.68 ± 0.12 Smoking: RG: 8; CG: 5 **Participants randomly assigned:** Randomised: 30 (exercise 11, breathing 11, control 8) Analysed: Rehab: exercise: 8, breathing: 7 Control: 6
Interventions	**Pulmonary rehabilitation:** Simple physical exercises at home under the supervision of a physiotherapist and every 2 weeks in the gymnasium LLE, ULE **Duration:** 10 weeks **Usual care:** placebo respiratory device and usual care
Outcomes	**Assessment:** baseline and 10 weeks 12-Minute WT, ICET, SSCET, daily diary, Lubin Affectometer
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation process: drawing lots
Allocation concealment (selection bias)	High risk	No concealment apparent
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, unable to blind both participants and those delivering the intervention

Jones 1985 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessments: not blinded for ICET, blinded for the others
Incomplete outcome data (attrition bias) All outcomes	High risk	Commenced: 19; completed: 14 (73.7%) Attrition: 26.3%
Selective reporting (reporting bias)	Low risk	No protocol was identified. All outcomes identified in the methods section of the paper are reported in the results
Other bias	High risk	Control received a placebo respiratory device, which may have an impact

Karapolat 2007

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** Dept Chest Medicinein Izmir, Turkey **Inclusion criteria:** • FEV_1 between 30% and 80% of predicted value • Clinical condition stable at the time of inclusion • No infections or COPD exacerbations in the preceding 4 weeks **Exclusion criteria:** • Severe medical problems such as heart failure, recent myocardial infarction, cerebrovascular disease, orthopaedic problems and severe liver or kidney problems **Participant status:** Age (years ± SD): RG: 64.81 ± 9.4; CG: 67.21 ± 6.72 Gender (M/F): RG: 21/5; CG: 18/1 FEV_1 %: RG: 55.50%; CG: 58% **Participants randomly assigned:** Randomised: 54 Analysed: Rehab: 26 Control: 19
Interventions	**Pulmonary rehabilitation:** out-patient programme Aerobic exercise, ULE, LLE, breathing exercises, educational material **Duration:** 8 weeks Education component: 16 sessions of discussion (1 hour/wk) Exercise component: 3 times a week **Usual care**
Outcomes	**Assessment:** baseline, week 8 and week 12

Karapolat 2007 *(Continued)*

	6MWT, SGRQ
Notes	Week 8 data used for analysis

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participants were randomly assigned in a 1:1 ratio with the use of sealed envelopes
Allocation concealment (selection bias)	Low risk	
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, unable to blind both participants and those delivering the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not informed
Incomplete outcome data (attrition bias) All outcomes	Low risk	Commenced: 49; completed: 45 Attrition: 18.17%
Selective reporting (reporting bias)	Low risk	No protocol was identified. All outcomes identified in the methods section of the paper are reported in the results
Other bias	Low risk	Participants who were excluded because they did not meet the criteria appear to have been excluded after randomisation

Lake 1990

Methods	**Study design:** RCT (4 groups); participants were randomly assigned to a control group and to 3 actively trained groups
Participants	**Setting:** intervention delivered in outpatient hospital setting; Perth, Western Australia **Inclusion criteria:** • Severe COPD • Condition stable • Demonstrated minimal bronchodilator response • Receiving maximal medical treatment • Never been involved in an exercise programme **Exclusion criteria:** • Unstable cardiac disease; musculoskeletal disability preventing exercise; cor pumonale; respiratory muscle fatigue (abdominal paradox) • Acute illness • Communication or transport difficulties **Participant status:**

Lake 1990 *(Continued)*

	Age (years ± SD): RG: 66.3 ± 6.8; CG: 65.7 ± 3.5 Gender (M/F): RG: 6/1; CG: 4/3 FEV_1 % (pred ± Sd): RG: 0.97 ± 0.29; CG: 0.83 ± 0.25 **Participants randomly assigned:** Randomised: 28 Analysed: Rehab: 7 Control: 7
Interventions	**Pulmonary rehabilitation:** out-patient hospital based: 4 groups (combined exercise: 7; upper limb: 6; lower limb: 7; control) LLE or ULE or both **Duration:** 8 weeks (1 hour 3 times per week) **Usual care**
Outcomes	**Assessment:** baseline and immediately after the 8 weeks 6MWT, ICET, IAET Bandura Scale of Well-being
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation process: randomisation chart
Allocation concealment (selection bias)	Unclear risk	No allocation concealment discussed
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, unable to blind participants and those delivering the intervention
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessments: blinded for ICET, not blinded for 6MWT
Incomplete outcome data (attrition bias) All outcomes	Low risk	Commenced: 28; finished: 26 (92.9%) Attrition: 7.1%
Selective reporting (reporting bias)	Low risk	No protocol was identified. All outcomes identified in the methods section of the paper were reported in the results
Other bias	Unclear risk	None noted

Lindsay 2005

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** Lek Yuen Family Medicine Teaching Clinic, Hong Kong, and the Family Medicine Training Centre of the Prince of Wales Hospital **Inclusion criteria:** • COPD: FEV_1 < 80% predicted and FEV_1/FVC ratio < 70% that does not change markedly over several months **Exclusion criteria:** • Could not walk; suffered from severe sensory or cognitive impairment, symptomatic ischaemic heart disease; or • Were on supplemental oxygen • Further exclusion criteria included glaucoma, prostate problems, pregnancy, breast-feeding, intolerance to ipratropium, bladder outlet problems and severe kidney problems, as these people would not be able to use tiotropium **Participant status:** Age (years ± SD): RG: 69.5 ± 9.3; CG: 69.8 ± 10.3 Gender (M/F): RG: 20/5; CG: 18/7 FEV_1 % (pred ± SD): RG: 0.9 ± 0.3; CG: 0.8 ± 0.4 Current smoker: RG 3 (12%); CG: 7 (28) **Participants randomly assigned:** Randomised: 50 (25 each group) Analysed: Rehab: 21 Control: 20
Interventions	**Pulmonary rehabilitation:** community (primary care setting) Aerobic exercise, ULE, LLE, educational material, home physio visits **Duration:** 6 weekly sessions of psychoeducation, each lasting for 2 hours **Usual care:** given tiotropium, which is considered standard usual care
Outcomes	**Assessment:** baseline, start of PRP, end of PRP and 3 months 6MWD, spirometry, CRQ
Notes	For analysis, used mean and standard deviation of all other studies, as did not provide SD

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not provided
Allocation concealment (selection bias)	Unclear risk	Not provided

Lindsay 2005 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, unable to blind participants and those delivering the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	50 randomly assigned; drop-out: 9 Attrition: 18%
Selective reporting (reporting bias)	Low risk	No protocol was identified. All outcomes identified in the methods section of the paper were reported in the results
Other bias	Low risk	None noted

Liu 2012

Methods	**Study design:** RCT (3 groups) Single-blind
Participants	**Setting:** conducted in Hong Kong, in the care of respiratory specialists of Jiangs Province Hospitals from October 2008 to October 2010 **Inclusion criteria:** COPD severity level at GOLD stages I and II **Exclusion criteria:** no serious co-morbidities (e.g. pulmonary tuberculosis, emphysema, congestive heart failure) **Participant status:** Age (years± SD):RG:[HQG: 61.82 ± 7.69; PRG: 61.34 ± 8.3]; CG: 62.2 ± 6.34 Gender (M/F): RG:[HQG: 78%/22%; RG: 72%/28%]; CG: 80%/20% FEV_1 % (pred ± SD): [HQG: 74.43 ± 12.93; PRP: 75.31 ± 12.84;] FEV_1 /FVC (± SD): RG[HQG: 60.73 ± 6.18; PRP: 61.27± 5.86]; control: 61.43 ± 6.17 Never smoked: HQG: 37.3%; PRP: 43.8%; control: 34.3% **Participants randomly assigned:** Randomised: 132 (PR: 36; Qiqong: 60; control: 36) Analysed: Rehab: 32 Control: 35
Interventions	**Pulmonary rehabilitation:** combined in-patient and/or home/community/out-patient Aerobic exercise, ULE, LLE, peer support **Duration:** 6 months; then encouraged to participate in peer-led weekly walking and ball game activities thrice a week, 1 hour each time, for 6 months **Usual care:** received health education and was advised to continue exercising alone

Liu 2012 *(Continued)*

Outcomes	**Assessment:** baseline and 6 months 6MWD, Zhongshan COPD Questionnaire for QoL, immune cell factor, hospital admissions
Notes	Used only exercise group for analysis

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participant allocation list was drawn on the basis of random order of the block ("H-H-H-P-P-C-C") for 20 times, until a list of 140 individuals in a specific order was obtained
Allocation concealment (selection bias)	Low risk	Not provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, participants and those delivering the programme could be randomly assigned
Blinding of outcome assessment (detection bias) All outcomes	Low risk	All outcome assessors were blinded to each participant's allocated group, as well as to the objectives of the study, to minimise bias
Incomplete outcome data (attrition bias) All outcomes	Low risk	Randomised: 132 (control: 36; PR: 36; Qigong: 60) 118 included in the final analysis (control: 35; PR: 32; Qigong: 51) So lost 14 overall (89%) participated; attrition: 11%
Selective reporting (reporting bias)	Low risk	No protocol was identified, but all results re stated outcomes seem to have been included
Other bias	Low risk	None noted

McGavin 1977

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** home based; New Delhi, India **Inclusion criteria:** • Younger than 70 years of age • Chronic bronchitis according to the criteria of the Medical Research Council **Exclusion criteria:** • Demonstrating reversibility post salbutamol • Taking corticosteroid medication • Patients with angina pectoris, intermittent claudication and disabling musculoskeletal disorders

McGavin 1977 *(Continued)*

	Participant status: Age (years ± SD): RG: 61.4 ± 5.6, CG: 57.2 ± 7.9 Gender (M/F): RG: 12/0; CG: 12/0 FEV_1 % (pred ± SD): RG: 0.97 L ± 0.33; CG: 1.15 L ± 0.72 FEV_1 /FVC: RG:CG **Participants randomly assigned:** Randomised: 28 Analysed: Rehab: 12 Control: 12
Interventions	**Pulmonary rehabilitation:** home-based training programme consisting of graded stair-climbing exercises tailored to suit the ability of the individual LLE **Duration:** continuous, once a day, at least 5 days a week **Usual care:** Control group did not receive exercise instructions or an out-patient check at 2 weeks
Outcomes	**Assessment:** baseline and mean 14 weeks control; mean 19 weeks intervention 12-Minute WT, ICET Interviews
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Used random numbers tables
Allocation concealment (selection bias)	Unclear risk	No information provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, participants and those delivering the programme could be randomly assigned
Blinding of outcome assessment (detection bias) All outcomes	High risk	Outcome assessments: not blinded (letter from study authors)
Incomplete outcome data (attrition bias) All outcomes	Low risk	28 started; 24 finished (85.7%) Attrition: 14.28%
Selective reporting (reporting bias)	Low risk	No protocol was identified, but all stated results re outcomes seem to have been included

McGavin 1977 *(Continued)*

Other bias	Low risk	None identified

McNamara 2013

Methods	**Study design:** RCT (3 groups, land based, water based, control)
Participants	**Setting:** patients referred to outpatient pulmonary rehabilitation at an Australian tertiary public hospital **Inclusion criteria:** • Diagnosis of COPD • In a stable phase • Presence of 1 or more physical co-morbidities (including musculoskeletal conditions affecting lumbar spine or lower limbs, 1 or more lower limb joint replacements restricting mobility and/or range of motion or peripheral vascular disease or neurological condition such as stroke or obesity with body mass index (BMI) > 32 kg/m^2) **Exclusion criteria:** • Unstable cardiac disease • Contraindications to water-based therapy such as uncontrollable incontinence or open wounds • Completed pulmonary rehabilitation in the past 12 months • Cognitive decline • Inability to understand oral and written English **Participant status:** Age (years ± SD): RG:[water: 72 ± 10; land: 73 ± 7]; CG: 70 ± 9 Gender (M/F): RG: 15/23; CG: 7/8 FEV_1 % (pred ± SD): RG: [WB: 60 ± 10; LB: 62 ± 15]; CG: 55 ± 20 FEV_1 /FVC: RG: [WB: 59 ± 9; LB: 58 ± 9]; CG: 53 ± 13 Current smokers: RG: [WB: 3; LB: 1]; CG: 2 **Participants randomly assigned:** Randomised: 53 (control: 15; land based: 20; water based: 18) Analysed: Rehab: land based: 15; water based: 15 Control: 15
Interventions	**Pulmonary rehabilitation:** out-patient programme: hospital gymnasium; participants walked at an intensity of 80% of the average 6MWT speed over ground or on a treadmill. Water-based exercise training group exercised in a hospital hydrotherapy pool Aerobic exercise, ULE, LLE **Duration:** 8 weeks; three 60-minute sessions a week of supervised exercise led by the same experienced physiotherapist **Usual care:**

McNamara 2013 *(Continued)*

	Control group participants received usual medical care and no exercise training. They were asked not to alter their exercise level over the study period
Outcomes	**Assessment:** baseline and 8 weeks CRDQ, 6MWT, ISWT, ESWT
Notes	Please note: Combined intervention groups of land and water used for analysis

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomly assigned by an investigator external to the study using a Web-based computer-generated sequence
Allocation concealment (selection bias)	Low risk	Concealed allocation achieved with the use of opaque envelopes
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the exercise interventions, it was not possible to blind therapists or participants to allocation
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessor blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Commenced: 53; analysed: 55 Attrition: 8 (15%)
Selective reporting (reporting bias)	Low risk	Registered on www.anzctr.org.au (ACTRN0126000408583) Primary outcomes and all planned secondary outcomes appear to have been reported
Other bias	Low risk	None noted

Mehri 2007

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** Iran **Inclusion criteria:** • COPD as recommended in GOLD **Exclusion criteria:** **Participant status:** Age (years ± SD): RG: 52.1 ± 10.7; CG: 52.17 ± 11.6

Mehri 2007 *(Continued)*

	Gender (M/F): RG: 11/9; CG: 7/11 FEV_1 % (pred): RG:CG: not available FEV_1 /FVC: RG:CG: not available **Participants randomly assigned:** Randomised: 38 (RG: 20, CG: 18) Analysed: Rehab: 20 Control: 18
Interventions	**Pulmonary rehabilitation:** outpatient clinic, exercised on a treadmill Aerobic exercise, ULE, LLE **Duration:** 4 weeks, 2 times a week **Usual care:** Control group completed no treadmill exercise training
Outcomes	**Assessment:** baseline and 4 weeks VO_2 peak, based on the Rockport formula
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No information provided
Allocation concealment (selection bias)	Unclear risk	No information provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the exercise interventions, it was not possible to blind therapists or participants to allocation
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	No attrition reported
Selective reporting (reporting bias)	Low risk	No protocol was identified, but all stated results re outcomes appear to have been included
Other bias	Low risk	None noted

Mendes De Oliveira 2010

Methods	**Study design:** RCT (3 groups); outpatient group that performed all activities at the clinic, home-based group that performed activities at home and control group
Participants	**Setting:** private pulmonology clinic in Cascavel (southern Brazil) **Inclusion criteria:** • COPD based on GOLD • Clinical stability in the 8 weeks before the study **Exclusion criteria:** • Hospitalisation; COPD instability • Presence of neuromuscular disease, associated respiratory disease, orthopaedic or neurological disease that affected gait • Recent impairment due to co-morbidities, such as myocardial infarction, heart failure, stroke or neoplasm; prior pneumonectomy or other thoracic surgery **Participant status:** Age (years): RG: [home: 66.4; outpatients: 71.3]; CG: 70.8 Gender (M/F): RG:[home: 27/6; outpatients: 19/4]: CG: 19/10 FEV_1 % (pred): RG:[home 47.5 ; outpatient 51.5]; CG: 41.4 **Participants randomly assigned:** Randomised: 117 Analysed: Rehab: home: 33; outpatient: 23 Control: 29
Interventions	**Pulmonary rehabilitation:** outpatient clinic or home based Aerobic exercise, ULE, LLE, education **Duration:** 12 weeks, 3 times a week **Usual care:** Control group performed no PR
Outcomes	**Assessment:** baseline and 12 weeks MRC, BODE Index, 6MWT
Notes	Combined 2 intervention groups for the analysis

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomly assigned electronically by a computer to 3 groups
Allocation concealment (selection bias)	Low risk	Not provided

Mendes De Oliveira 2010 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, unable to blind participants and those delivering intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	2 duly trained healthcare professionals were responsible for the evaluations, which were performed by the same evaluators for all participants
Incomplete outcome data (attrition bias) All outcomes	High risk	Loss: 32; attrition: 27%
Selective reporting (reporting bias)	Low risk	No protocol was identified, but all stated results re outcomes appear to have been included
Other bias	Low risk	None noted

Nalbant 2011

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** nursing home residents in Turkey **Inclusion criteria:** • 60-85 years of age • Diagnosed with COPD **Exclusion criteria:** • Systemic diseases affecting the respiratory system, requiring treatment • Arrhythmias and/or congestive heart failure, allergic rhinitis, atopy, with a history of malignancy • Continuous oxygen therapy • Acute COPD attacks in the period, steroid • Narcotic analgesics and chronic alcohol **Participant status:** Age (years): RG: 73.5; CG: 68 Gender (M/F): RG: 11/3; CG: 13/2 FEV_1/FVC (Range): RG: 58.5 (48-65); CG: 57 (44-66) **Participants randomly assigned:** Randomised: 29 (RG: 14, CG: 15) Analysed: Rehab: 10 Control: 11
Interventions	**Pulmonary rehabilitation:** Aerobic exercise, ULE, LLE, educational material

Nalbant 2011 *(Continued)*

	Duration: 6 months, 3 days a week for 1.5 hours **Usual care**
Outcomes	**Assessment:** baseline, 3 months and 6 months 6MWT, lower extremity strength test
Notes	Note: Only medians and ranges provided, so cannot be used in analysis

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not provided
Allocation concealment (selection bias)	Unclear risk	Not provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, unable to blind participants and those providing intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not provided
Incomplete outcome data (attrition bias) All outcomes	High risk	29 people were randomly assigned 21 completed; loss of 8 people Attrition: 28%
Selective reporting (reporting bias)	Low risk	No protocol was identified, but seems to have included all results re outcomes stated
Other bias	Low risk	None noted

O'Shea 2007

Methods	**Study design:** RCT (2 groups); single- blind randomised trial
Participants	**Setting:** 4 sites including 3 regional health services and 1 large metropolitan hospital; Australia **Inclusion criteria:** • Diagnosis of COPD **Exclusion criteria:** • Respiratory condition other than COPD • Unstable medical conditions limiting performance of resistance exercise

O'Shea 2007 *(Continued)*

	• PR in previous 12 months **Participant status:** Age (years ± SD): RG: 66.9 ± 7: CG: 68.4 ± 9.9 Gender (M/F): RG:CG FEV_1 % (pred): RG: 49; CG: 52 FEV_1/FVC: RG: 50; CG: 49 Hx smoking per day: RG: 40; CG: 26.5 **Participants randomly assigned:** Randomised: 54 (27 to each group) Analysed: Rehab: 20 Control: 24
Interventions	**Pulmonary rehabilitation:** outpatient clinic and home based: under the supervision of an experienced physiotherapist; progressive resistance exercise programme ULE, LLE **Duration:** 12 weeks: 1 session per week facilitated, 2 sessions performed independently at home **Usual care:** Control group received no intervention
Outcomes	**Assessment:** baseline and 3 months and 6 months CRDQ, 6MWT, Timed Up and Go Test, Grocery Shelving Test, Patient-Specific Functional Scale, participation restrictions: London Handicap Scale, hand-held dynamometry
Notes	Utilised data at 3 months for analysis

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Generated by member of the research team not involved in participant recruitment
Allocation concealment (selection bias)	Low risk	Concealed allocation
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants and those delivering the intervention were aware of which individuals were included in the intervention group
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessor blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Commenced: 54; loss: 44 Attrition: 19%

O'Shea 2007 *(Continued)*

Selective reporting (reporting bias)	Low risk	No protocol was identified, but all results re stated outcomes appear to have been included
Other bias	High risk	All male

Ozdemir 2010

Methods	**Study design:** RCT (2 groups): water based exercise (WE) and control
Participants	**Setting:** Chest Diseases Outpatient Clinic between April 2006 and November 2006; Turkey **Inclusion criteria:** • Moderate or severe COPD **Exclusion criteria:** • Without respiratory failure • Severe hypertension • Dizziness or fainting during exercise • Severe congestive heart failure that could not be controlled • Under treatment • Unstable coronary artery disease, terminal liver failure • Psychiatric instability, behavioural disorder • Suspected bronchial asthma • Ongoing infectious disease **Participant status:** Age (years ± SD): RG: 60.9 ± 8.8; CG: 64.1 ± 8.9 Gender (M/F): all male FEV_1 % (pred ± SD): RG: 54.5 ± 15.6; CG: 54.1 ± 20.2 FEV_1/FVC (± SD) : RG: 56.0 ± 10.5; CG: 54.6 ± 9.1 Smoker: RG: 5 (20%); CG: 6 (24%) **Participants randomly assigned:** Randomised: 50 (25 in each) Analysed: Rehab: 25 Control: 25
Interventions	**Pulmonary rehabilitation:** out-patient; water-based exercise (WE) Aerobic exercise, ULE, LLE **Duration:** 4-Week water-based pulmonary rehabilitation for 35 minutes 3 times a week **Usual care:** received only medical therapy
Outcomes	**Assessment:**

Ozdemir 2010 *(Continued)*

	baseline and 1 month Spirometry, 6MWT, CRDQ, HAD Scale, arterial blood gas examination
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	According to "tables of random numbers"
Allocation concealment (selection bias)	Unclear risk	No information provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention were aware of allocation
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	No attrition reported
Selective reporting (reporting bias)	High risk	No protocol was identified, but results for CRQ of rehabilitation group were not provided
Other bias	Low risk	None noted

Paz-Diaz 2007

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** recruited from the pulmonary clinic at the University Hospital of Caracas **Inclusion criteria:** • COPD diagnosed • Clinically stable • Receiving optimal medical therapy **Exclusion criteria:** • Not clinically stable **Participant status:** Age (years ± SD): RG: 67 ± 5; CG: 62 ± 7 Gender (M/F): RG: 6/4; CG: 12/2 FEV_1 % (pred ± SD): RG: 34 ± 11; CG: 30 ± 9

Paz-Diaz 2007 *(Continued)*

	FEV_1/FVC (± SD): RG: 39 ± 7; CG: 30 ± 9 **Participants randomly assigned:** Randomised: 24 (PG: 10; CG: 14) Analysed: 24 Rehab: 10 Control: 14
Interventions	**Pulmonary rehabilitation:** out-patient programme (hospital-based PR) Aerobic exercise, ULE, LLE **Duration:** 8-Week programme 3 days per week in groups of 2 or 3 **Usual care:** Control group received optimal care, as suggested by the American Thoracic Society
Outcomes	**Assessment:** baseline and Immediately after PR (8 weeks) Spirometry, Beck Depression Inventory, State Trait Anxiety Inventory, MRC Scale, SGRQ
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not informed
Allocation concealment (selection bias)	Unclear risk	Not informed
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention were aware of allocation
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not informed
Incomplete outcome data (attrition bias) All outcomes	Low risk	Commenced: 24 (control: 14; intervention: 10) No loss reported
Selective reporting (reporting bias)	High risk	No protocol was identified, but results for the rehabilitation group for CR were not provided
Other bias	Low risk	None noted

Petty 2006

Methods	**Study design:** RCT (3 groups): randomised tailored videotape, standard videotape, control
Participants	**Setting:** physician referrals from private offices, the Denver office of Kaiser Permanente

Petty 2006 *(Continued)*

	and the Denver Veterans Affairs Medical Center **Inclusion criteria:** • Diagnosis of COPD, emphysema or chronic bronchitis; FEV_1 < 50% and predicted ratio FEV_1/FVC < 70% • Stable state **Exclusion criteria:** • Terminal condition such as late-stage lung cancer • Active involvement in a formal pulmonary rehabilitation programme **Participant status:** Age (years ± SD): RG: [customised video: 68.8 ± 9.2; standard video: 68.4 ± 9.0]; CG: 66.8 ± 9.9 Gender (M): RG:[customised video: 39 (54.2%); standard video: 41 (59.4%)]; CG: 40 (54.8%) Current smoker: RG:[customised video: 10 ± 14.3%); standard video: 18 ± 26.5%]; CG: 22 ±30.1% **Participants randomly assigned:** Randomised: 214 (customised video: 72; standard video: 69; control: 73) Analysed: Rehab: customised video: 52; standard video: 62 Control: 61
Interventions	**Pulmonary rehabilitation:** home-based programme (in home): a tailored videotape (Group A) and a standard videotape (Group B) Aerobic exercise, ULE, LLE, educational material, home physio visits **Duration:** 8 weeks **Usual care**
Outcomes	**Assessment:** baseline and 8 weeks Fatigue Impact Scale (FIS), Seattle Obstructive Lung Questionnaire (SOLQ), SF-36, 6MWD
Notes	Data could not be analysed, as full results were not available

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomly assigned to 1 of 3 groups in a blocked fashion to achieve balance
Allocation concealment (selection bias)	Unclear risk	Not known
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention were aware of allocation

Petty 2006 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Low risk	Self-completion by participants
Incomplete outcome data (attrition bias) All outcomes	Low risk	Randomly assigned: 214; completed: 174 Attrition: 40 (19%)
Selective reporting (reporting bias)	High risk	No protocol was identified Results of the 6-minute walk test and SF-36 not presented
Other bias	Unclear risk	None noted

Reardon 1994

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** out-patient; Connecticut **Inclusion criteria:** • Clinical diagnosis of moderately severe to severe COPD • Significant exertional dyspnoea despite conventional medical therapy **Exclusion criteria:** • Significant associated medical problems that might interfere with ability to undergo OPR • Requiring continuous low-flow oxygen therapy **Participant status:** Age (yearsn): RG: 66.3; CG: 66.1 Gender (M/F): RG: 5/5; CG: 5/5 FEV_1 % (pred ± SD): RG: 35% ± 10; CG: 33% ± 15 **Participants randomly assigned:** Randomised: 20 Analysed: Rehab: 10 Control: 10
Interventions	**Pulmonary rehabilitation:** outpatient LLE, ULE, BE, Edu, Psy **Duration:** 6 weeks (12 three-hour sessions) **Usual care:** session with the OPR nurse clinician for optimisation of pulmonary therapy
Outcomes	**Assessment:** baseline and 6 weeks ITT, BDI/TDI, 12MWD
Notes	

Reardon 1994 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation process: random numbers table
Allocation concealment (selection bias)	Unclear risk	Not informed
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention were aware of allocation
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessments: blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	No participant loss after allocation
Selective reporting (reporting bias)	Low risk	No trial registration protocol was found at www.controlled-trials.com/mrct/ or www.who.int/trialsearch (searched for author names and parts of title of paper or intervention). However it would seem that all outcomes stated in the study were measured
Other bias	Low risk	None noted

Ringbaek 2000

Methods	**Study design:** RCT (2 groups) Randomisation process: sealed envelopes Outcome assessments: blinded
Participants	**Setting:** delivered as an outpatient programme in Denmark **Inclusion criteria:** • Stable COPD with FEV_1/FVC ratio 570%, FEV_1 > 0.6 • Age < 75 years • Oxygen saturation without oxygen supply > 90% **Exclusion criteria:** • In an exercise programme • Had another serious disease, such as cancer • Had home oxygen therapy • Were senile or suffered from a psychiatric disorder, or were dependent on walking equipment **Participant status:**

Ringbaek 2000 *(Continued)*

	Age (years ± SD): RG: 61.8 ± 6.8; CG: 64.6 ± 7.7 Gender (M/F): RG: 1/23; CG: 6/15 FEV_1 % (pred ± SD): RG: 49.5 ± 17.4; CG: 44.3 ± 3.7 Current smoking: RG: 16; CG: 7 **Participants randomly assigned:** Randomised: 45 (RG: 24; control: 21) Analysed: Rehab: 17 Control: 19 (130 approached; 45 randomised)
Interventions	**Pulmonary rehabilitation:** out-patient (hospital) Aerobic, LLE, ULE, education, nutritional support **Duration:** 8 weeks, 2 sessions a week of 2 hours **Usual care:** conventional community care
Outcomes	**Assessment:** baseline and 8 weeks 6-Minute WT, SGRQ, Psychological General Well-being (PGWB), Borg Scale
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation process: sealed envelopes
Allocation concealment (selection bias)	Unclear risk	No information provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention were aware of allocation
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessments: blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	Overall commenced: 45; finished: 36 (84.4%) Overall attrition: 7 (15.6%)
Selective reporting (reporting bias)	Low risk	No trial registration protocol was found at www.controlled-trials.com/mrct/ or www.who.int/trialsearch (searched for author names and parts of title of paper or intervention). However it would seem that all outcomes stated in the study were measured
Other bias	Low risk	None noted

Simpson 1992

Methods	**Study design:** RCT (2 groups), stratified
Participants	**Setting:** out-patient **Inclusion criteria:** • Clinically stable state, no recent infective exacerbation • Drug management considered to be optimal • $FEV_1/VC < 0\ 7$ • Body weight within 30% of predicted ideal body weight **Exclusion criteria:** • NOT clinically stable state • Recent infective exacerbation • Disorders likely to affect exercise and capacity to participate **Participant status:** Age (years ± SD): RG: 73 ± 4.8; CG: 70 ± 5.7 Gender (M/F): RG: 5/9; CG: 10/4 FEV_1 % (pred ± SD): RG: 39.5 ±18.96; CG: 39.2 ± 21.39 FEV_1/FVC: RG: 49.4 (12.95); CG: 47.8 (14.04) **Participants randomly assigned:** Randomised: 34 Analysed: Rehab: 14 Control: 14
Interventions	**Pulmonary rehabilitation:** Weight-lifting programme training was prescribed for upper and lower limb muscles; resistance was increased progressively LLE, ULE **Duration:** 8 weeks 3 times a week **Usual care:** Control group attended only for testing
Outcomes	**Assessment:** baseline and 8 weeks 6MWT, ICET, SSCET, CRQ
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation process: coin toss

Simpson 1992 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	No information provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention were aware of allocation
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessments: blinded for CRQ, not blinded for the others
Incomplete outcome data (attrition bias) All outcomes	Low risk	28/34 completed = 82.3% Attrition: 17.64%
Selective reporting (reporting bias)	Low risk	No trial registration protocol was found. However it would seem that all outcomes stated in the study were measured
Other bias	Low risk	None noted

Singh 2003

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** home based, carried out by Department of Medicine, SMS Medical College and Hospital, Jaipur, India **Inclusion criteria:** • Stable patients • Chronic bronchitis and/or emphysema with FEV/FVC ratio < 0.7 and FEV_1 • Less than 40% of predicted • Dyspnoea in 3 or more daily activities • Given up smoking for at least 2 months **Exclusion criteria:** • Involved in a pulmonary rehabilitation programme • Right ventricular failure, unstable ischaemic heart disease • Oxygen saturation < 88% at rest • Musculoskeletal disease, acute exacerbation and pneumothorax **Participant status:** Age (years ± SD): 59.3 ± 6.4 Gender (M/F): male 32 (80%), female 8 (20%) FEV_1 % (pred ± SD): RG: 28 ± 7.5; CG: 26 ± 7.1 FEV_1/FVC (±SD): RG: 44 ± 16; CG: 48 ± 10.4 **Participants randomly assigned:** Randomised: 40

Singh 2003 *(Continued)*

	Analysed: Rehab: 20 Control: 20
Interventions	**Pulmonary rehabilitation:** domiciliary pulmonary rehabilitation for 4 weeks; supervised weekly to ensure that participants were following the rehabilitation schedule properly and were taking regular treatment LLE, IMT **Duration:** 4 weeks 30 minutes twice a day **Usual care:** Control group participants were asked to continue their activities as usual
Outcomes	**Assessment:** baseline and 4 weeks CRQ, 6MWT
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation process: random numbers table
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention were aware of allocation
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Outcome assessments: not reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	No attrition
Selective reporting (reporting bias)	Low risk	All outcomes appearing in the controlled trial registry (clinicaltrials.gov) seem to have been reported on in the paper
Other bias	Low risk	None reported

Sridhar 2008

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** community and hospital care in West London

Sridhar 2008 *(Continued)*

	Inclusion criteria: • Patients who had been discharged with a diagnosis of acute exacerbation of COPD as primary cause of admission **Exclusion criteria:** • Significant comorbidity such as severe heart disease or cancer • Any condition that would preclude participation in the physical therapy component **Participant status:** Age (years ± SD): RG: 69.9 ± 9.6; CG: 69.68 ± 10.4 Gender (M/F): RG: 30/31; CG: 30/31 FEV_1 % (pred ± SD): RG: 42.9 ±15.5; CG: 48.9 ± 18.69 FEV_1/FVC: RG:CG Current smoker (Y/N): RG: 18/61; CG: 12/61 **Participants randomly assigned:** Randomised: 122 Analysed: Rehab: 47 Control: 40
Interventions	**Pulmonary rehabilitation:** outpatient followed by home package Aerobic exercise, ULE, LLE, educational material, home physio visits **Duration:** 4 weeks, 2 attendances per week (1 hour of education, 1 hour of physical training) followed by 3 monthly home visits **Usual care:** Control group received usual care from primary care physician
Outcomes	**Assessment:** baseline and 6 months CRQ, hospital readmission rate
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomly assigned with the use of random numbers to intervention or control group
Allocation concealment (selection bias)	Unclear risk	Not informed
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention were aware of allocation

Sridhar 2008 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Outcome assessments: not reported
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Commenced: 122; outcome data for 104 Attrition: 18 (15%)
Selective reporting (reporting bias)	Low risk	No trial registration protocol was found. However it would seem that all outcomes stated in the study were measured
Other bias	Unclear risk	None reported

Strijbos 1996

Methods	**Study design:** RCT (3 groups)
Participants	**Setting:** out-patient **Inclusion criteria:** **Exclusion criteria:** **Participant status:** Age (years ± SD): RG: 61 ± 6 ; CG: 63 ± 5 Gender (M/F): RG: 14/1; CG: 12/3 FEV_1 % (pred ± SD): RG: 40.4 ±19.6; CG: 42.6 ± 8.8 **Participants randomly assigned:** Randomised: 32 Analysed: Rehab: 15 Control: 15
Interventions	**Pulmonary rehabilitation:** hospital-based outpatient pulmonary rehabilitation programmes (HRPa) are compared with those of a 12-week home care rehabilitation programme (HCRP) LLE, BE, PD, Edu, Psy **Duration:** 12 weeks twice a week for 1-hour session **Usual care:** Control group received no rehabilitation therapy
Outcomes	**Assessment:** baseline, 3 months, 6 months, 12 months and 18 months 4-Minute WT, ICET, interviews
Notes	Utilised 3-month results for analysis

Strijbos 1996 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Lottery procedure used to determine which group participants allocated to.
Allocation concealment (selection bias)	Unclear risk	No information related to allocation concealment provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention would be aware of allocation
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessments: blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	Started 50; finished 45; attrition at 3 months: 5 (10%)
Selective reporting (reporting bias)	Low risk	No trial registration protocol was found. However it would seem that all outcomes stated in the study were measured
Other bias	Low risk	None noted

Theander 2009

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** pulmonary out-patient department in a central county district of Sweden **Inclusion criteria:** • 75 years of age or younger • FEV_1 between 60% and 25% predicted after bronchodilatation **Exclusion criteria:** • Disabling or severe disease other than COPD • Impaired pulmonary function due to other disease • Long-term oxygen therapy • Alpha1-antitrypsin deficiency, cancer disease, untreated obstructive sleep apnoea syndrome, no COPD-related symptoms affecting activities of daily life **Participant status:** Age (years): RG: 66; CG: 64 Gender (M/F): RG: 3/9; CG: 10/4 FEV_1 % (pred ± SD): RG: 35.1 ± 7.6; CG: 32.3 ± 9.5 Smokers: 3 in each group currently smoking

Theander 2009 *(Continued)*

	Participants randomly assigned: Randomised: 30 Analysed: Rehab: 12 Control: 14
Interventions	**Pulmonary rehabilitation:** out-patient programme (hospital based followed by home based), multi-disciplinary; comprising a physiotherapist, a dietician, an occupational therapist and a nurse. After 1 month, individualised home exercise added Aerobic exercise, ULE, LLE, breathing exercises, educational material, nutrition **Duration:** 12 weeks 2 days per week,1 hour long **Usual care:** Control group received none of the multi-disciplinary rehabilitation programmes and no care from multi-disciplinary professionals
Outcomes	**Assessment:** baseline and 12 weeks 6MWD, SQRQ, hand grip strength and health perception, fatigue, functional limitations due to fatigue, functional performance and satisfaction
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation procedures were performed by an independent person from the research group, who took a random envelope from the prepared box with sealed envelopes
Allocation concealment (selection bias)	Low risk	For this purpose, we prepared 80 sealed opaque envelopes with assignment information
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention would be aware of allocation
Blinding of outcome assessment (detection bias) All outcomes	High risk	Data collection was performed by members of the rehabilitation group. Data collected were not blinded to the data collector
Incomplete outcome data (attrition bias) All outcomes	Low risk	26/30 complete data for analysis 4/30 lost to follow-up = 13.33%
Selective reporting (reporting bias)	Low risk	No trial registration protocol was found. However it would seem that all outcomes stated in the study were measured
Other bias	Low risk	None noted

Vallet 1994

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** in-patient; France **Inclusion criteria:** • Diagnosis of COPD • Obstruction not reversible • History smoking 30 packs/y on average **Exclusion criteria:** • Heart failure • $PaO_2 \leq 60$ mmHg or with hypercapnia • Current infection **Participant status:** Age (years ± SD): RG: 59.6 ± 2.75; CG: 58.2 ± 1.8 Gender (M/F): RG: 7/3; CG: 8/2 FEV_1/FVC: RG: 57.2; CG: 55.7 **Participants randomly assigned:** Randomised: 22 Analysed: Rehab: 10 Control: 10
Interventions	**Pulmonary rehabilitation:** in-patient rehabilitation LLE, BE **Duration:** 8 weeks **Usual care**
Outcomes	**Assessment:** baseline and 2 months ICET QoL: not measured
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation process: drawing lots Outcome assessments: not blinded
Allocation concealment (selection bias)	Unclear risk	No information related to allocation concealment provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention would be aware of allocation

Vallet 1994 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	High risk	Outcome assessments: not blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	18/20 (90%) completed
Selective reporting (reporting bias)	Low risk	No trial registration protocol was found. However it would seem that all outcomes stated in the study were measured
Other bias	Low risk	None noted

Van Wetering 2010

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** **Inclusion criteria:** • Impaired exercise capacity • Stage 2 or 3 COPD • Willing to participate in a community-based programme **Exclusion criteria:** 1. Prior rehabilitation 2. Serious co-morbidity that precluded exercise therapy · 3. Lack of motivation to participate in the treatment programme **Participant status:** Age (years ± SD): RG: 65.9 ± 8.8; CG: 67.2 ± 8.9 Gender (M/F): 71% male in each group FEV_1 % (pred ± SD): RG: 58 ±17; CG: 60 ±15 FEV_1/FVC: RG: 49 ±11; CG: 36.1 ± 26.4 Current smokers (%): RG: 33%; CG: 24% **Participants randomly assigned:** Randomised: 199 Analysed: Rehab: 87 Control: 88
Interventions	**Pulmonary rehabilitation:** community (primary care setting) Standardised supervised rehabilitation phase and a 20-month active maintenance phase Aerobic exercise, ULE, LLE, educational material

Van Wetering 2010 *(Continued)*

	Duration: Initally 4-Month, followed by 20-month active maintenance phase (twice a day during 30 minutes) **Usual care:** received pharmacotherapy according to accepted guidelines
Outcomes	**Assessment:** baseline and 4 months (immediately after initial intervention) SGRQ, cycle endurance test (CET), 6MWD, muscle strength (handgrip force (HGF), isometric quadriceps peak torque (QPT), maximal inspiratory mouth pressure (Pimax)), 17 body composition (FFM)
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Care provided through a computerised procedure with concealed participant allocation
Allocation concealment (selection bias)	Low risk	Programme or usual care through a computerised procedure with concealed participant allocation
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention would be aware of allocation
Blinding of outcome assessment (detection bias) All outcomes	Low risk	All measurements were assessed single-blind
Incomplete outcome data (attrition bias) All outcomes	Low risk	Loss = 24 (12%) (intervention: 15 (4.7%); control: 9 (9.2%)) 88% completed, so 12% attrition
Selective reporting (reporting bias)	Low risk	From protocol paper (http://clinicaltrials.gov/ct2/show/NCT00840892), outcomes matched those in the protocol paper
Other bias	Low risk	None noted

Vijayan 2010

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** India **Inclusion criteria:** • Moderate to severe, as per GOLD guidelines. • 8 weeks on standard inhalational therapy • 4 weeks post exacerbation

Vijayan 2010 *(Continued)*

	Exclusion criteria: **Participant status:** Age (years): not provided Gender: not provided FEV_1 %: not provided FEV_1/FVC: not provided **Participants randomly assigned:** Randomised: 31 (15 control; 16 intervention) Analysed: Rehab: 16 Control: 15
Interventions	**Pulmonary rehabilitation:** not informed of venue Aerobic exercise, ULE, LLE **Duration:** 8 weeks (5 days a week for 90 minutes) **Usual care:** Both groups had medication adjusted for 8 weeks
Outcomes	**Assessment:** baseline 6-Minute walk test (Only relevant test)
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No Information
Allocation concealment (selection bias)	Unclear risk	No details provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention would be aware of allocation
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No details provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	No attrition reported
Selective reporting (reporting bias)	Unclear risk	Insufficent details provided

Vijayan 2010 *(Continued)*

Other bias	High risk	Very superficial information available in relation to the study, precluding good quality assessment

Weiner 1992

Methods	**Study design:** RCT (3 groups): SIMT group received threshold inspiratory muscle trainer and exercise programme, exercise training group and control randomly matched to 3 groups according to the following criteria: age; FEV_1; and FEV_1/FVC
Participants	**Setting:** out-patient; Isreal **Inclusion criteria:** • Spirometric evidence of chronic airflow limitation that was not corrected by bronchodilator therapy **Exclusion criteria:** **Participant status:** Age (years ± SD): RG: 64.4 ± 3; CG: 62.3 ± 2.4 Gender (M/F): RG: 6/6; CG: 5/7 FEV_1 % (pred ± SD): RG: 32.8 ± 3; CG: 39.2 ± 2.8 **Participants randomly assigned:** Randomised: 24 Analysed: Rehab: 12 Control: 12
Interventions	**Pulmonary rehabilitation:** out-patient (hospital) Performed under the supervision of a physiotherapist LLE, ULE, IMT, BE **Duration:** 6 months, 3 times a week, each session consisting of 1 hour of training **Usual care:** no additional treatment
Outcomes	**Assessment:** baseline and 6 months 12-Minute WT, ICET, SSCET QoL: not measured
Notes	1 exercise only group used in the analysis

Risk of bias

Bias	Authors' judgement	Support for judgement

Weiner 1992 *(Continued)*

Random sequence generation (selection bias)	Low risk	Randomisation process: random numbers table
Allocation concealment (selection bias)	Unclear risk	No information related to allocation concealment provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention would be aware of allocation
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessments: blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	No loss to follow-up
Selective reporting (reporting bias)	High risk	No trial registration protocol was found. Results of SGRQ not available
Other bias	Low risk	None noted

Wen 2008

Methods	**Study design:** RCT (3 groups) High-intensity group Anaerobic threshold group Control group
Participants	**Setting:** out-patient clinic in China **Inclusion criteria:** • Diagnosis of COPD based on GOLD guidelines **Exclusion criteria:** • Suffered from disability of lower extremity, serious cardiovascular disease (including unstable angina pectoris, uncontrolled congestive heart failure, acute myocardial infarction, uncontrolled hypertension, frequent premature atrial or ventricular contraction, severe pulmonary hypertension), postexercise syncope • Severe disorder of hepatic and renal function • Cognitive learning disability and mental illness **Participant status:** Age (years± SD): RG: [ATG: 67 ± 7; HIG: 68 ± 7]; CG: 66 ± 10 Gender (M/F): all male with exception of 1 FEV_1% (pred ± SD): RG:[ATG: 46 ± 10; HIG: 50 ± 14;] CG: 52 ± 14

Wen 2008 *(Continued)*

	Participants randomly assigned: Randomised: 41 (high-intensity group: 17; anaerobic threshold group: 15; control group: 9) Analysed: Rehab: High-intensity group: 17; anaerobic threshold group: 15 Control: 9
Interventions	**Pulmonary rehabilitation:** bicycle exercise training Aerobic exercise, LLE **Duration:** 12 weeks, 2 days a week **Usual care**
Outcomes	**Assessment:** baseline and 12 weeks SGRQ, Borg/Max Oxygen Intake
Notes	No results available for the SGRQ

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No Information
Allocation concealment (selection bias)	Unclear risk	No details provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention would be aware of allocation
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No details provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	54 randomly assigned, 13 lost Attrition: 24%
Selective reporting (reporting bias)	Low risk	No trial registration protocol was found. However it would seem that all outcomes stated in the study were measured
Other bias	Low risk	None noted

Wijkstra 1994

Methods	**Study design:** RCT (2 groups), stratified
Participants	**Setting:** home based

Wijkstra 1994 *(Continued)*

	Inclusion criteria: • Clinically stable condition (no recent exacerbations) • Optimal drug management. • FEV_1 < 60% predicted; FEV_1/vital capacity (IVC) < 50%; after bronchodilator **Exclusion criteria:** • Evidence of ischaemic heart disease, intermittent claudication • Musculoskeletal disorders or other disabling diseases that could restrict the rehabilitation programme **Participant status:** Age (years ± SD): RG: 64 ± 5; CG: 62 ± 5 Gender (M/F): RG: 23/5; CG: 14/1 FEV_1% (pred ± SD): RG: 44 ± 11; CG: 45 ± 9 FEV_1/FVC (± SD): RG: 39 ± 8; CG: 36 ± 7 **Participants randomly assigned:** Randomised: 45 (RG: 30; CG: 15) Analysed: Rehab: 28 Control: 15
Interventions	**Pulmonary rehabilitation:** out-patient clinic and home based: progressive physiotherapy programme LLE, ULE, IMT, BE, Edu, Psy, nurse home visited **Duration:** 12 weeks, twice a week In addition, participants had to practice twice a day for half an hour at home **Usual care:** Control group did not follow the above mentioned protocol
Outcomes	**Assessment:** baseline and 12 weeks 6-Minute WT, ICET CRQ
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation process: stratified randomisation
Allocation concealment (selection bias)	Unclear risk	No details provided
Blinding of participants and personnel (performance bias)	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention would be aware of allocation

Wijkstra 1994 *(Continued)*
All outcomes

Blinding of outcome assessment (detection bias) All outcomes	High risk	Not blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	43/45 = 95.6% completed Attrition rate: 4.4%
Selective reporting (reporting bias)	Low risk	No trial registration protocol was found. However it would seem that all outcomes stated in the study were measured
Other bias	Low risk	None noted

Xie 2003

Methods	**Study design:** RCT (2 groups)
Participants	**Setting:** home-based affiliated central hospital of Jilin Medical College, China **Inclusion criteria:** • Diagnosing standard for chronic obstructive pulmonary disease established by the respiratory branch of the Chinese Medical Association **Exclusion criteria:** • Ischaemic heart disease, severe uncontrolled hypertension, alteration in thoracic cage • Neuromuscular disorders or intermittent claudication or osteoarticular lesions in lower extremities that would affect mobilisation **Participant status:** Age (years± SD): RG: 54 ±6; CG: 54 ± 6 Gender (M/F): RG: 22/3; CG: 21/4 FEV_1% (pred ± SD): RG: 41.8 ± 15; CG: 40 ± 16.5 FEV_1/FVC(±SD): RG: 40.3 ± 9.3; CG: 42.3 ± 12.1 **Participants randomly assigned:** Randomised: 50 Analysed: Rehab: 25 Control: 25
Interventions	**Pulmonary rehabilitation:** 1 home rehabilitation walking programme; training intensity was individually determined LLE **Duration:** 12 weeks, 6 days a week, duration of 1 hour **Usual care:** Control group participants (medical treatment alone) also made visits to the hospital every 2 weeks for clinical checkup

Xie 2003 *(Continued)*

Outcomes	**Assessment:** baseline and 12 weeks ICE, SWT, dyspnoea, lung function, blood gas
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation process: random numbers table
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	As a result of the nature of the intervention, both participants and those delivering the intervention would be aware of allocation
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Outcome assessments: not reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	No mention of attrition
Selective reporting (reporting bias)	Low risk	No trial registration protocol was found. However it would seem that all outcomes stated in the study were measured
Other bias	Low risk	None noted

6MWT: six-minute walk test; BDI/TDI: baseline dyspnoea index/transition dyspnoea index; BE: breathing exercises; CRQ: Chronic Respiratory Disease Questionnaire; Edu: education; IAET: incremental arm ergometer test; ICET: incremental cycle ergometer test; IMT: inspiratory muscle training; ITT: incremental treadmill test; LLE: lower limb exercise; NEADL: Nottingham Extended Actvities of Daily Living scale; PD: postural drainage; POMS: profile of mood state; Psy: psychological support; QoL: quality of life; SGRQ: St. George's Respiratory Questionnaire; SIP: sickness impact profile; SSCET: steady-state cycle ergometer test; SSTT: steady-state treadmill test; ULE: upper limb exercise; WT: walk test; HADS: Hospital Anxiety Depression Scale.

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Akinci 2011	Not a randomised controlled trial
Ambrosino 1981	Experimental group did not receive exercise training
Ambrosino 2006	Control group does not receive 'usual care'
Amin 2011	Control group does not receive 'usual care'
Arnadottir 2001	Control group does not receive 'usual care'

Study	Reason for exclusion
Backer 2003	Control group does not receive 'usual care'
Bauldoff 1996	Control group does not receive 'usual care'
Bauldoff 2002	Wrong aim
Behnke 2002	No control group
Behnke 2002a	Control group does not receive 'usual care'
Behnke 2003	No control group
Bernard 1999	Control group does not receive 'usual care'
Berry 1996	Control group does not receive 'usual care'
Bjerre-Jepsen 1981	No physical exercise component
Bourbeau 2000	No physical exercise component
Bourjeily-Habr 2002	No physical exercise component
Breyer 2010	Control group does not receive 'usual care'
Brooks 2000	Control group does not receive 'usual care'
Böhning 1990	Wrong comparison
Cai 2003	No physical exercise component
Carrieri-Kohlman 96	Control group does not receive 'usual care'
Cegla 2002	No physical exercise component
Chen 2011	Control group does not receive 'usual care'
Ciric 2008	Not a randomised controlled trial
Clark 2000	FEV_1 higher than 70% of predicted
Cockcroft 1985	Control group does not receive 'usual care'
Coppoolse 1999	Control group does not receive 'usual care'
Covey 2004	Not a randomised controlled trial (review article)
Cox 1993	Not a randomised controlled trial
de Blasio 2000	Not a randomised controlled trial (editorial)
de Lucas Ramos 1998	Experimental group does not receive exercise training
Dekhuijzen 1990	Control group does not receive 'usual care'
Dekhuijzen 1991	Control group does not receive 'usual care'

Study	Reason for exclusion
Demir-Deriven 2001	Control group does not receive 'usual care'
Demir-Deriven 2002	Wrong comparison (men compared with women)
Dewse 1998	Not a randomised controlled trial (review article)
Di Marzo 2000	No physical exercise component
Downes Vogel 2002	No physical exercise component
Dushianthan 2009	Not a randomised controlled trial (review article)
Egan 2012	Not a randomised controlled trial
Ellum 2002	Wrong comparison (effect of posture on dyspnoea)
Emtner 1998	Not COPD
Epstein 1997	Control group does not receive 'usual care'
Esteve 1996	Control group does not receive 'usual care'
Fan 2008	Control group does not receive 'usual care'
Foglio 2001	Control group does not receive 'usual care'
Gadoury 2005	Control group does not receive 'usual care'
Gale 2009	Not a randomised controlled trial
Garuti 2010	Not a randomised controlled trial (review article)
Gautier 1998	Control group does not receive 'usual care'
Gautier 2002	Control group does not receive 'usual care'
Ghanem 2010	Participants not clearly 4 weeks post exacerbation
Gimenez 2000	Control group does not receive 'usual care' Quasi-randomisation
Girodo 1992	Not COPD
Goldman 1997	FEV_1 is higher than 70% predicted
Gormley 1993	Control group does not receive 'usual care'
Gosselink 1990	Control group does not receive 'usual care'
Green 1999	Control group does not receive 'usual care'
Griffiths 1996	Control group does not receive 'usual care'
Grosbois 1999	Control group does not receive 'usual care'

Study	Reason for exclusion
Gu 2011	No physical exercise component
Guell 2006	Control group does not receive 'usual care'
Harver 1989	Experimental group did not receive exercise training
Hawkins 1999	No physical exercise component
Hentschel 2002	Control group does not receive 'usual care'
Holland 2003	Control group does not receive 'usual care'
Hospes 2009	No physical exercise component
Houchen 2011	Control group does not receive 'usual care'
Innocenti 2000	Control group does not receive 'usual care'
Jensen 1983	No physical exercise component
Johnson 2000	Control group does not receive 'usual care'
Jungblut 2007	Not a randomised controlled trial
Kaplan 1990	Control group does not receive 'usual care'
Katsura 2000	Control group does not receive 'usual care'
Kurabayashi 1998	Experimental group does not receive exercise training
Kurabayashi 2000	Experimental group does not receive exercise training
Larson 1999	Control group does not receive 'usual care'
Lathlean 2008	Randomisation unclear
Laukandt 1998	Control group does not receive 'usual care'
Levine 1986	Wrong comparison
Lewczuk 1998	Not a randomised controlled trial
Li 2002	No physical exercise component
Liu 2002	Randomisation unclear
Lotshaw 2003	Control group does not receive 'usual care'
Ma 2002	Control group does not receive 'usual care'
Mador 2002	Healthy controls
Mador 2004	Control group does not receive 'usual care'
Make 2000	Non-randomised comparison

Study	Reason for exclusion
Martinez 1993	Control group does not receive 'usual care'
McKeogh 2012	Control group does not receive 'usual care'
Morgan 1999	Not a randomised controlled trial (review)
Moros Garcia 1996	Not randomised
Morris 2003	Control group does not receive 'usual care'
MTU 2003	Systematic review
Murphy 2004	Control group does not receive 'usual care'
Myers 2000	Enhancement strategy
Na 2005	Not a randomised controlled trial
Nasilowski 2011	Not a randomised controlled trial
Nava 1998	Unstable patients (wrong population)
Ndundu 2001	Case series
Neder 2002	Control group does not receive 'usual care'
Newall 2000	Control group does not receive 'usual care'
Nguyen 2005	Control group does not receive 'usual care'
Ninot 2011	Outcomes measured longer than 3 months after the end of the intervention
Nosworthy 1992	Control group does not receive 'usual care'
Nygren-Bonnier 2002	Control group does not receive 'usual care'
O'Hara 1987	Not a randomised controlled trial
Ortega 2002	Control group does not receive 'usual care'
Patessio 1994	Control group does not receive 'usual care'
Petersen 2008	Control group does not receive 'usual care'
Piantadosi 2000	No randomised comparison between PR and control group
Pison 2001	Not a randomised controlled trial (review article)
Pison 2008	Control group does not receive 'usual care'
Pitta 2004	Not a randomised controlled trial
Ponsioen 2010	Not a randomised controlled trial (review article)
Prince 1989	Control group does not receive 'usual care'

Study	Reason for exclusion
Probst 2003	Acute effect of walking aid on exercise capacity
Proshchaev 2009	Control group does not receive 'usual care'
Puente 1996	2 types of training compared
Raschke 1990	Not randomised
Regiane Resqueti 2007	Control group does not receive 'usual care'
Reilly 2000	NETT trial does not meet entry criteria for the review
Riario-Sforza 2009	Randomisation unclear
Ries 1986	Control group does not receive 'usual care'
Ries 1988	Control group does not receive 'usual care'
Ries 1995	Control group does not receive 'usual care'
Roberts 1999	Control group does not receive 'usual care'
Rooyackers 1996	Control group does not receive 'usual care'
Rudkin 1997	Control group does not receive 'usual care'
Santiworakul 2009	Randomisation unclear
Sassi-Dambron 1995	Experimental group does not receive exercise training
Saunders 1965	No physical exercise component
Scherer 1998	Control group does not receive 'usual care'
Scorsone 2010	Control group does not receive 'usual care'
Semenyuk 2007	No physical exercise component
Serres 1997	Inadequate duration (shorter than 4 weeks)
Sewell 2005	Control group does not receive 'usual care'
Sinclair 1980	Not a randomised controlled trial
Sindhwani 2011	Not a randomised controlled trial
Sivori 1998	Control group does not receive 'usual care'
Solanes Garcia 2004	Randomisation unclear
Sparrow 1997	Control group does not receive 'usual care'
Spruit 2001	Control group does not receive 'usual care'
Steele 2008	Control group does not receive 'usual care'

Study	Reason for exclusion
Stellefson 2009	Not an exercise programme
Sudo 1997	Control group does not receive 'usual care'
Sugawara 2007	Control group does not receive 'usual care'
Sun 2003	No physical exercise component
Swerts 1990	Control group does not receive 'usual care'
Taylor 2012	Not an exercise programme
Toevs 1984	Control group does not receive 'usual care'
Troosters 1999	Not a randomised controlled trial (review article)
Tsang 2001	Control group does not receive 'usual care'
Ubaidullayev 1990	No physical exercise component
Vargas 1998	No physical exercise component
Vogiatzis 1999	Treatment allocation not randomised
Vogiatzis 2001	Control group does not receive 'usual care'
Vogiatzis 2002	Control group does not receive 'usual care'
Wadell 2005	Not a randomised controlled trial
Wadell 2013	Control group does not receive 'usual care'
Wanke 1994	Control group does not receive 'usual care'
Wedzicha 1998	Control group does not receive 'usual care'
Weiner 1992a	Not COPD
Wen 2004	Participants not clearly 4 weeks post exacerbation and length of intervention unclear
White 2002	Control group does not receive 'usual care'
Worth 1985	Not randomised
Xu 2010	Length of programme unclear
Yamanaka 2009	Not a randomised controlled trial
Yan 1996	Experimental group does not receive exercise training
Yosbauran 1996	Control group does not receive 'usual care'
Zanini 2002	Control group does not receive 'usual care'
Zhang 2008	No physical exercise component

COPD: chronic obstructive pulmonary disease; FEV_1: forced expiratory volume in one second; NETT: National Emphysema Treatment Trial; PR: pulmonary rehabilitation.

Characteristics of studies awaiting assessment *[ordered by study ID]*

Aksu 2006

Methods	3 groups
Participants	58 participants
Interventions	**Pulmonary rehab:** aerobic exercise group; aerobic exercise plus isotonic strengthening exercise group; control group with no exercise **Duration:** 3 times per week for 12 weeks **Usual care:** not known
Outcomes	**Assessment:** baseline and 12 weeks Exercise performance (measured by Bruce exercise tolerance test), 6MWT, dyspnoea scores, SGRQ, SF-36, BMI and pulmonary function
Notes	Not possible to establish contact with study authors

D'Amico 2010

Methods	Not known
Participants	RCT (2 groups)
Interventions	**Pulmonary rehabilitation:** indoor aerobic training **Duration:** 3 days per week, 60 minutes each time, for 6 months **Usual care:** not known
Outcomes	Spirometry, oxygen saturation, ambulatory blood pressure measurement, health-related quality of life (SF-12)
Notes	Not possible to establish contact with study authors

Meshcheryakova 2010

Methods	RCT (4 groups)
Participants	57 participants
Interventions	**Pulmonary rehabilitation:** physical training **Duration:** not known **Usual care:** standardised medication
Outcomes	6-Minute walk test, respiratory muscle strength, health-related quality of life (SF-36), lung function

Meshcheryakova 2010 *(Continued)*

Notes	Contact information: m_natalia1967@inbox.ru

Meshcheryakova 2012

Methods	RCT (3 groups)
Participants	45 participants
Interventions	**Pulmonary rehabilitation:** a physical exercise programme **Duration:** not known
Outcomes	BMI, pulmonary function, 6MWT, shortness of breath, health-related quality of life (SF-36), systemic inflammation blood indicators, blood testosterone, muscle power and depression
Notes	Contact information: m_natalia1967@inbox.ru

Ren 2011

Methods	RCT (3 groups)
Participants	89 patients with COPD, divided into groups according to severity of COPD
Interventions	**Pulmonary rehabilitation:** 2 different programmes used for 20 weeks **Usual care:** not known
Outcomes	**Assessment:** baseline and 20 weeks 6MWT, BODE Index, acute exacerbation frequency, Modified Medical Research Council Scale, BMI and pulmonary function (FEV_1)
Notes	Not possible to establish contact with study authors

6MWT: six-minute walk test; BMI: body mass index; COPD: chronic obstructive pulmonary disease; FEV_1: forced expiratory volume in one second; RCT: randomised controlled trial; SF: Short Form; SGRQ: St. George's Respiratory Questionnaire.
Six studies were awaiting classification in the previous version of the review (Corrado 1995; Fernández 1998; Shu 1998; Tregonning 2000; Ward 1999; Wright 2002). The current search yielded no related publications since 2006 to allow us to clarify the status of these studies.

Characteristics of ongoing studies *[ordered by study ID]*

Chang 2008

Trial name or title	Pulmonary rehabilitation or self-management (PRSM) for chronic obstructive pulmonary disease (COPD)
Methods	RCT (3 groups) Individual randomisation, blinded outcome assessment, 3-monthly follow-up assessments across a 12-month period and concurrent economic evaluation
Participants	Target of 85 per group

Chang 2008 *(Continued)*

Interventions	Stanford Chronic Disease Self-Management programme vs multi-factorial pulmonary rehabilitation group vs usual care provided by a GP
Outcomes	Primary outcome measure is St. George's Respiratory Disease Questionnaire Secondary outcome measures are measured by Frenchay Activities Index, International Physical Activity Questionnaire, the Hospital Anxiety and Depression Scale, the COPD Self-Efficacy scale and 2 physiological measures (forced vital capacity in 1 second and an incremental shuttle walk) measured at baseline and at 3-monthly intervals across 12 months. Also, spirometry and incremental shuttle walk at baseline and at 3 months
Starting date	April 2008
Contact information	terrence.haines@monash.edu
Notes	Results not yet published

Gurgun 2011

Trial name or title	Efficacy of an Eight-Week Pulmonary Rehabilitation in COPD Patients: An Experience of a Single Center in Turkey
Methods	RCT (2 groups)
Participants	152 stable patients with COPD
Interventions	8-Week pulmonary rehabilitation programme vs usual care
Outcomes	**Assessment:** at 8 weeks Walking distance, perceived dyspnoea, health-related quality of life, anxiety and depression
Starting date	Not known
Contact information	alev.gurgun@ege.edu.tr
Notes	Study still recruiting at the time of this review

Sathyapala 2008

Trial name or title	Comparison of Repetitive Magnetic Stimulation (rMS) and Exercise Versus No Active Treatment on Quadriceps Function in Chronic Obstructive Pulmonary Disease (COPD)
Methods	RCT (3 groups)
Participants	58
Interventions	**Pulmonary rehabilitation:** supervised 2-hour resistance and endurance exercise programme twice a week for 8 weeks **Repetitive magnetic stimulation** of the intramuscular branches of the femoral nerve for 3 hours twice a week for 8 weeks **Usual care:** no intervention

Sathyapala 2008 *(Continued)*

Outcomes	**Assessment** at 8 weeks Lung function, fat-free mass, quadriceps strength, locomotion time and movement intensity over a 2-day period
Starting date	2007
Contact information	m.polkey@imperial.ac.uk
Notes	Results not yet published

One ongoing study in the previous version of the review (Whiteford 2004) remains unpublished.

DATA AND ANALYSES

Comparison 1. Rehabilitation versus usual care

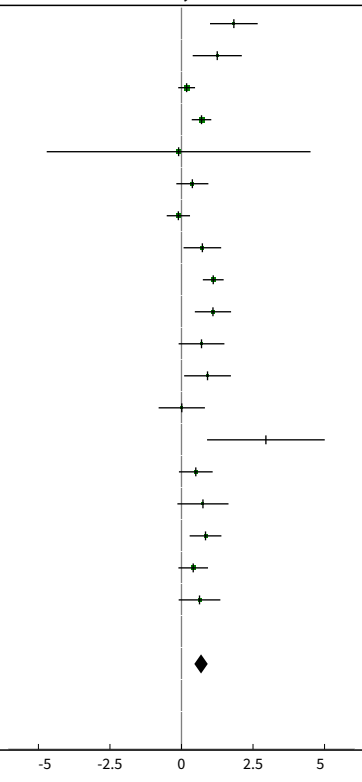
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 QoL - Change in CRQ (Fatigue)	19	1291	Mean Difference (IV, Random, 95% CI)	0.68 [0.45, 0.92]
2 QoL - Change in CRQ (Emotional Function)	19	1291	Mean Difference (IV, Random, 95% CI)	0.56 [0.34, 0.78]
3 QoL - Change in CRQ (Mastery)	19	1212	Mean Difference (IV, Random, 95% CI)	0.71 [0.47, 0.95]
4 QoL - Change in CRQ (Dyspnoea)	19	1283	Mean Difference (IV, Random, 95% CI)	0.79 [0.56, 1.03]
5 QoL - Change in SGRQ (Total)	19	1146	Mean Difference (IV, Random, 95% CI)	-6.89 [-9.26, -4.52]
6 QoL - Change in SGRQ (Symptoms)	19	1153	Mean Difference (IV, Random, 95% CI)	-5.09 [-7.69, -2.49]
7 QoL - Change in SGRQ (Impacts)	19	1149	Mean Difference (IV, Random, 95% CI)	-7.23 [-9.91, -4.55]
8 QoL - Change in SGRQ (Activity)	19	1148	Mean Difference (IV, Random, 95% CI)	-6.08 [-9.28, -2.88]
9 Maximal Exercise (Incremental shuttle walk test)	8	694	Mean Difference (IV, Random, 95% CI)	39.77 [22.38, 57.15]
10 Maximal Exercise Capacity (cycle ergometer)	16	779	Mean Difference (IV, Random, 95% CI)	6.77 [1.89, 11.65]
11 Functional Exercise Capacity (6MWT))	38	1879	Mean Difference (IV, Random, 95% CI)	43.93 [32.64, 55.21]

Analysis 1.1. Comparison 1 Rehabilitation versus usual care, Outcome 1 QoL - Change in CRQ (Fatigue).

Study or subgroup	Pulmonary rehab		Usual care		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Random, 95% CI		Random, 95% CI
Behnke 2000a	15	1.6 (0.8)	15	-0.2 (1.5)		4.34%	1.83[1,2.66]
Cambach 1997	15	1.3 (1)	8	0 (1)		4.2%	1.25[0.39,2.11]
Casey 2013	176	0.5 (1.3)	170	0.3 (1.5)		8.34%	0.18[-0.11,0.47]
Cebollero 2012	28	0.7 (0.8)	8	0 (0.2)		7.98%	0.7[0.36,1.04]
Faulkner 2010	6	-0.5 (3.8)	8	-0.4 (5)		0.25%	-0.1[-4.71,4.51]
Goldstein 1994	40	0.1 (1.2)	40	-0.3 (1.4)		6.2%	0.38[-0.18,0.94]
Gomez 2006	36	0.3 (0.7)	14	0.4 (0.7)		7.45%	-0.11[-0.52,0.3]
Gosselink 2000	34	0.6 (1.2)	28	-0.1 (1.4)		5.47%	0.73[0.07,1.39]
Griffiths 2000	93	1 (1.4)	91	-0.1 (1.1)		7.8%	1.11[0.75,1.47]
Güell 1995	29	0.8 (1.1)	27	-0.3 (1.3)		5.65%	1.1[0.47,1.73]
Güell 1998	18	0.2 (1.1)	17	-0.5 (1.3)		4.53%	0.7[-0.1,1.5]
Hernandez 2000	20	0.9 (1.5)	17	0 (1.1)		4.43%	0.91[0.09,1.73]
Lindsay 2005	21	0.4 (1.3)	20	0.4 (1.3)		4.48%	0.01[-0.8,0.82]
McNamara 2013	30	2.4 (3.5)	15	-0.6 (3.3)		1.14%	2.95[0.89,5.01]
O'Shea 2007	27	0.4 (1.2)	27	-0.1 (1)		5.97%	0.5[-0.09,1.09]
Simpson 1992	14	1 (1.2)	14	0.3 (1.2)		4.01%	0.75[-0.14,1.64]
Singh 2003	20	0.9 (0.9)	20	0.1 (0.9)		6.24%	0.84[0.29,1.39]
Sridhar 2008	47	0.1 (1.4)	40	-0.3 (1.1)		6.54%	0.41[-0.11,0.93]
Wijkstra 1994	28	0.9 (1.3)	15	0.3 (1.1)		4.98%	0.63[-0.1,1.36]
Total ***	**697**		**594**			**100%**	**0.68[0.45,0.92]**

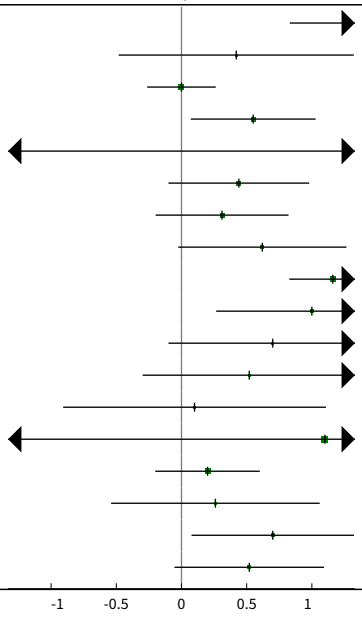
Heterogeneity: Tau^2=0.15; Chi^2=50.33, df=18(P<0.0001); I^2=64.23%

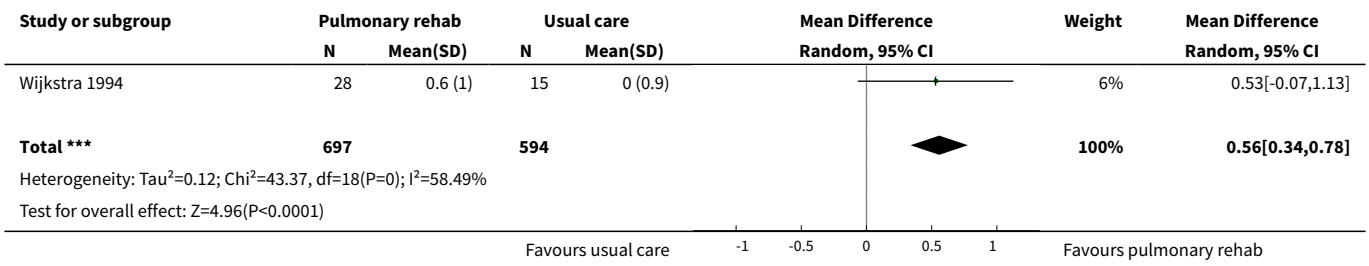
Test for overall effect: Z=5.72(P<0.0001)



Analysis 1.2. Comparison 1 Rehabilitation versus usual care, Outcome 2 QoL - Change in CRQ (Emotional Function).

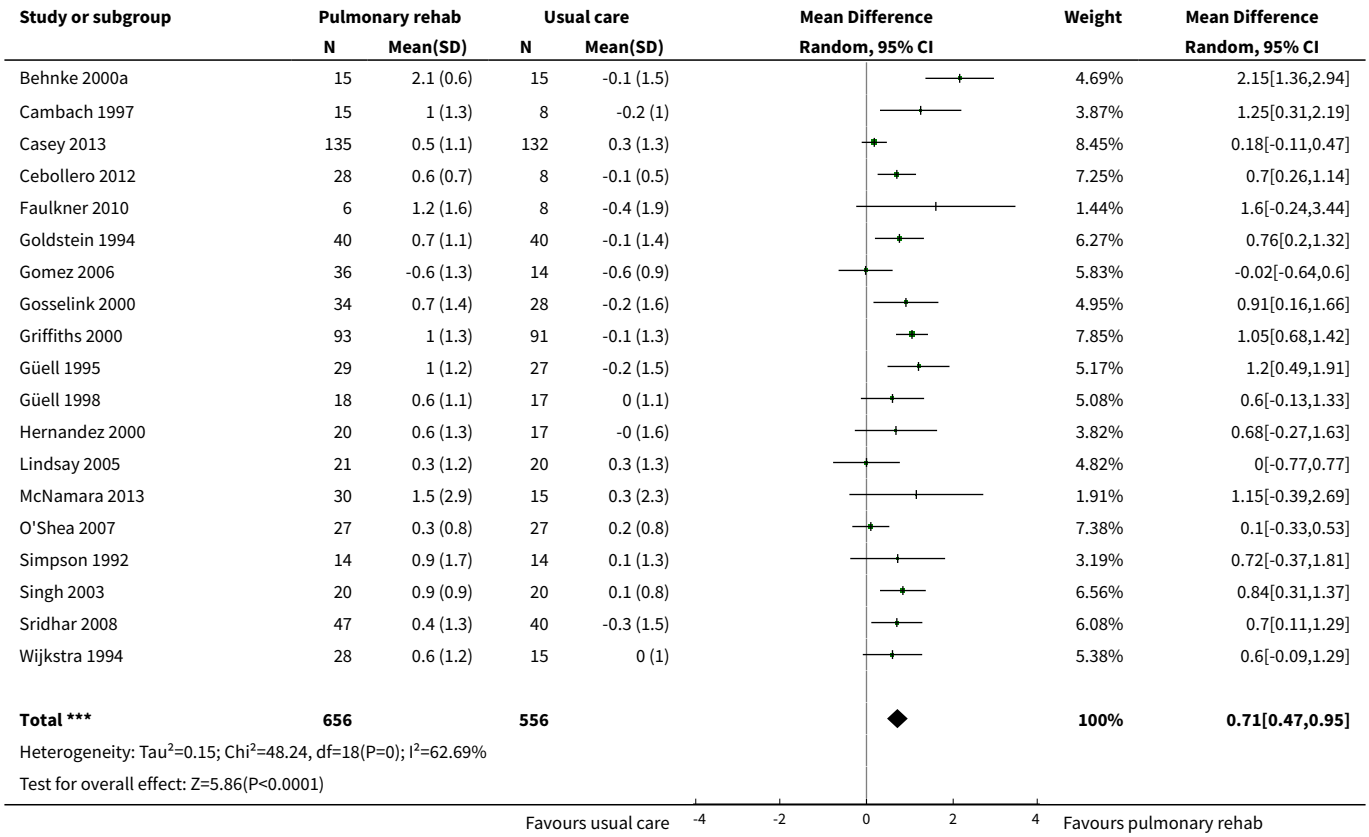
Study or subgroup	Pulmonary rehab		Usual care		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Random, 95% CI		Random, 95% CI
Behnke 2000a	15	1.5 (0.9)	15	-0.2 (1.4)		4.14%	1.68[0.83,2.53]
Cambach 1997	15	0.7 (1.1)	8	0.3 (1)		3.84%	0.42[-0.48,1.32]
Casey 2013	176	0.2 (1.2)	170	0.2 (1.3)		9.28%	0[-0.26,0.26]
Cebollero 2012	28	0.7 (0.6)	8	0.1 (0.6)		7.11%	0.55[0.07,1.03]
Faulkner 2010	6	-0.2 (3.7)	8	-2.6 (6.8)		0.15%	2.4[-3.16,7.96]
Goldstein 1994	40	0.2 (1.2)	40	-0.2 (1.3)		6.52%	0.44[-0.1,0.98]
Gomez 2006	36	0.8 (0.8)	14	0.5 (0.8)		6.81%	0.31[-0.2,0.82]
Gosselink 2000	34	0.5 (1.2)	28	-0.1 (1.3)		5.58%	0.62[-0.03,1.27]
Griffiths 2000	93	1 (1.1)	91	-0.2 (1.2)		8.6%	1.16[0.83,1.49]
Güell 1995	29	0.9 (1.4)	27	-0.1 (1.4)		4.9%	1[0.27,1.73]
Güell 1998	18	0.2 (1.1)	17	-0.5 (1.3)		4.44%	0.7[-0.1,1.5]
Hernandez 2000	20	0.8 (1.2)	17	0.3 (1.3)		4.33%	0.52[-0.3,1.34]
Lindsay 2005	21	0.4 (1.9)	20	0.3 (1.4)		3.31%	0.1[-0.91,1.11]
McNamara 2013	30	1.8 (4.5)	15	0.7 (4)		0.69%	1.1[-1.47,3.67]
O'Shea 2007	27	0.4 (0.8)	27	0.2 (0.7)		7.9%	0.2[-0.2,0.6]
Simpson 1992	14	0.4 (1.1)	14	0.1 (1.1)		4.44%	0.26[-0.54,1.06]
Singh 2003	20	0.9 (1.1)	20	0.2 (0.9)		5.77%	0.7[0.08,1.32]
Sridhar 2008	47	0.2 (1.4)	40	-0.4 (1.3)		6.2%	0.52[-0.05,1.09]





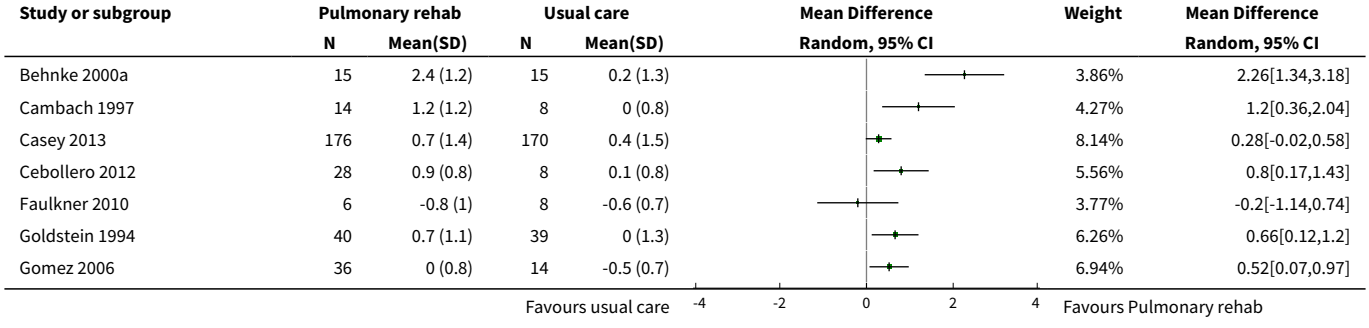
Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Wijkstra 1994	28	0.6 (1)	15	0 (0.9)		6%	0.53[-0.07,1.13]
Total ***	**697**		**594**			**100%**	**0.56[0.34,0.78]**
Heterogeneity: Tau²=0.12; Chi²=43.37, df=18(P=0); I²=58.49%							
Test for overall effect: Z=4.96(P<0.0001)							

Analysis 1.3. Comparison 1 Rehabilitation versus usual care, Outcome 3 QoL - Change in CRQ (Mastery).



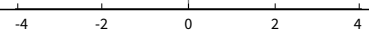
Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Behnke 2000a	15	2.1 (0.6)	15	-0.1 (1.5)		4.69%	2.15[1.36,2.94]
Cambach 1997	15	1 (1.3)	8	-0.2 (1)		3.87%	1.25[0.31,2.19]
Casey 2013	135	0.5 (1.1)	132	0.3 (1.3)		8.45%	0.18[-0.11,0.47]
Cebollero 2012	28	0.6 (0.7)	8	-0.1 (0.5)		7.25%	0.7[0.26,1.14]
Faulkner 2010	6	1.2 (1.6)	8	-0.4 (1.9)		1.44%	1.6[-0.24,3.44]
Goldstein 1994	40	0.7 (1.1)	40	-0.1 (1.4)		6.27%	0.76[0.2,1.32]
Gomez 2006	36	-0.6 (1.3)	14	-0.6 (0.9)		5.83%	-0.02[-0.64,0.6]
Gosselink 2000	34	0.7 (1.4)	28	-0.2 (1.6)		4.95%	0.91[0.16,1.66]
Griffiths 2000	93	1 (1.3)	91	-0.1 (1.3)		7.85%	1.05[0.68,1.42]
Güell 1995	29	1 (1.2)	27	-0.2 (1.5)		5.17%	1.2[0.49,1.91]
Güell 1998	18	0.6 (1.1)	17	0 (1.1)		5.08%	0.6[-0.13,1.33]
Hernandez 2000	20	0.6 (1.3)	17	-0 (1.6)		3.82%	0.68[-0.27,1.63]
Lindsay 2005	21	0.3 (1.2)	20	0.3 (1.3)		4.82%	0[-0.77,0.77]
McNamara 2013	30	1.5 (2.9)	15	0.3 (2.3)		1.91%	1.15[-0.39,2.69]
O'Shea 2007	27	0.3 (0.8)	27	0.2 (0.8)		7.38%	0.1[-0.33,0.53]
Simpson 1992	14	0.9 (1.7)	14	0.1 (1.3)		3.19%	0.72[-0.37,1.81]
Singh 2003	20	0.9 (0.9)	20	0.1 (0.8)		6.56%	0.84[0.31,1.37]
Sridhar 2008	47	0.4 (1.3)	40	-0.3 (1.5)		6.08%	0.7[0.11,1.29]
Wijkstra 1994	28	0.6 (1.2)	15	0 (1)		5.38%	0.6[-0.09,1.29]
Total ***	**656**		**556**			**100%**	**0.71[0.47,0.95]**
Heterogeneity: Tau²=0.15; Chi²=48.24, df=18(P=0); I²=62.69%							
Test for overall effect: Z=5.86(P<0.0001)							

Analysis 1.4. Comparison 1 Rehabilitation versus usual care, Outcome 4 QoL - Change in CRQ (Dyspnoea).



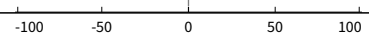
Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Behnke 2000a	15	2.4 (1.2)	15	0.2 (1.3)		3.86%	2.26[1.34,3.18]
Cambach 1997	14	1.2 (1.2)	8	0 (0.8)		4.27%	1.2[0.36,2.04]
Casey 2013	176	0.7 (1.4)	170	0.4 (1.5)		8.14%	0.28[-0.02,0.58]
Cebollero 2012	28	0.9 (0.8)	8	0.1 (0.8)		5.56%	0.8[0.17,1.43]
Faulkner 2010	6	-0.8 (1)	8	-0.6 (0.7)		3.77%	-0.2[-1.14,0.74]
Goldstein 1994	40	0.7 (1.1)	39	0 (1.3)		6.26%	0.66[0.12,1.2]
Gomez 2006	36	0 (0.8)	14	-0.5 (0.7)		6.94%	0.52[0.07,0.97]

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Gosselink 2000	34	0.8 (1.3)	28	-0 (1.3)		5.44%	0.82[0.17,1.47]
Griffiths 2000	93	1 (1.3)	91	-0.2 (1)		7.88%	1.18[0.85,1.51]
Güell 1995	29	1.2 (1.4)	27	-0.1 (1.1)		5.4%	1.3[0.64,1.96]
Güell 1998	18	0.8 (1.2)	17	-0.2 (1.2)		4.52%	1[0.2,1.8]
Hernandez 2000	20	1.1 (1.1)	17	0.3 (1.2)		4.74%	0.78[0.02,1.54]
Lindsay 2005	21	1.2 (1.3)	20	1.1 (1.3)		4.5%	0.06[-0.74,0.86]
McNamara 2013	30	2.2 (3.8)	15	0 (1.8)		1.7%	2.15[0.52,3.78]
O'Shea 2007	27	0.6 (1.5)	27	0 (1)		5.25%	0.6[-0.08,1.28]
Simpson 1992	12	1.2 (1.1)	10	0 (0.8)		4.32%	1.2[0.37,2.03]
Singh 2003	20	1 (0.9)	20	0.1 (0.8)		6.31%	0.88[0.35,1.41]
Sridhar 2008	47	-0.7 (1.2)	40	-0.8 (1.2)		6.45%	0.12[-0.39,0.63]
Wijkstra 1994	28	0.9 (1)	15	-0 (1.3)		4.68%	0.9[0.13,1.67]
Total ***	**694**		**589**			**100%**	**0.79[0.56,1.03]**
Heterogeneity: Tau^2=0.15; Chi^2=48.85, df=18(P=0); I^2=63.15%							
Test for overall effect: Z=6.62(P<0.0001)							



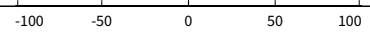
Analysis 1.5. Comparison 1 Rehabilitation versus usual care, Outcome 5 QoL - Change in SGRQ (Total).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Baumann 2012	37	-7 (10.5)	44	-1 (8.2)		8.27%	-6[-10.16,-1.84]
Boxall 2005	23	-5.8 (11.8)	23	-1.4 (13.3)		5.43%	-4.4[-11.67,2.87]
Chan 2011	69	3.4 (16.1)	67	4 (14.8)		7.24%	-0.6[-5.8,4.6]
Chlumsky 2001	13	-4.1 (19.8)	6	-4.2 (19.2)		1.4%	0.15[-18.6,18.9]
De Souto Araujo 2012	21	-11.5 (14.5)	11	6.5 (8.8)		4.84%	-17.94[-26.04,-9.85]
Deering 2011	11	-6.2 (8.6)	13	3.9 (9.4)		5.46%	-10.03[-17.27,-2.79]
Elci 2008	39	-14.4 (11.6)	39	3.8 (17.4)		6%	-18.2[-24.76,-11.64]
Engström 1999	26	0.3 (17.3)	24	0.5 (16.2)		4.11%	-0.2[-9.49,9.09]
Fernandez 2009	27	-14.7 (13.8)	14	-2.5 (12.7)		4.61%	-12.2[-20.65,-3.75]
Finnerty 2001	24	-9.3 (12.2)	25	-2.2 (15)		5.16%	-7.1[-14.74,0.54]
Gohl 2006	10	-7.3 (25)	9	2 (24)		1.05%	-9.3[-31.34,12.74]
Gottlieb 2011	17	-5.2 (14.2)	18	0.4 (11.3)		4.55%	-5.62[-14.15,2.91]
Griffiths 2000	93	-7.1 (15.5)	91	1.3 (11.7)		8.48%	-8.4[-12.36,-4.44]
Gurgun 2013	30	-6.4 (8.1)	16	-0.2 (0.7)		9.52%	-6.27[-9.18,-3.36]
Karapolat 2007	26	-16.8 (15.2)	19	-3.7 (17.3)		3.87%	-13.1[-22.83,-3.37]
Paz-Diaz 2007	10	-7 (12)	14	3 (16)		3.19%	-10[-21.21,1.21]
Ringbaek 2000	17	-2.1 (19)	19	-2.2 (17)		2.95%	0.1[-11.73,11.93]
Theander 2009	12	7.6 (10.8)	14	2.6 (12.2)		4.36%	5[-3.84,13.84]
Van Wetering 2010	87	-3.9 (10.3)	88	0.3 (9.4)		9.51%	-4.2[-7.11,-1.29]
Total ***	**592**		**554**			**100%**	**-6.89[-9.26,-4.52]**
Heterogeneity: Tau^2=13.17; Chi^2=43.39, df=18(P=0); I^2=58.52%							
Test for overall effect: Z=5.7(P<0.0001)							



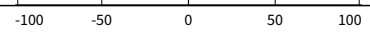
Analysis 1.6. Comparison 1 Rehabilitation versus usual care, Outcome 6 QoL - Change in SGRQ (Symptoms).

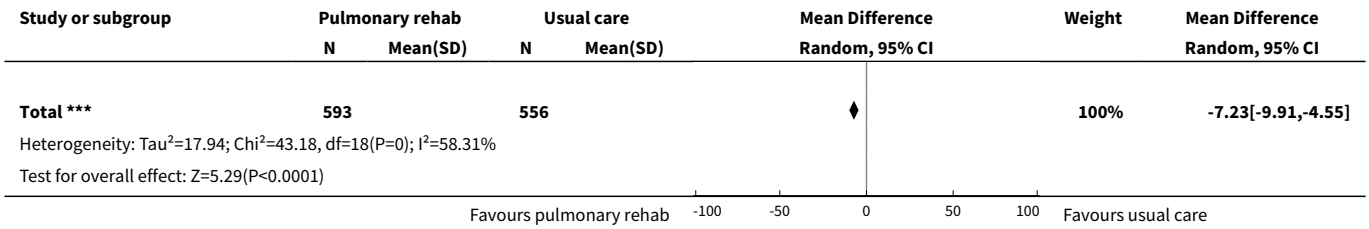
Study or subgroup	Pulmonary rehab		Usual care		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Random, 95% CI		Random, 95% CI
Baumann 2012	37	-2 (18)	44	-5 (19.7)		6.94%	3[-5.22,11.22]
Boxall 2005	23	2 (18.9)	23	-0.6 (19.3)		4.46%	2.6[-8.44,13.64]
Chan 2011	69	-1.2 (18.2)	67	4.5 (20.1)		9.46%	-5.7[-12.15,0.75]
Chlumsky 2001	13	-3.1 (23.2)	6	-4 (33.4)		0.75%	0.82[-28.73,30.37]
De Souto Araujo 2012	21	-7.8 (21.9)	11	3.9 (8.5)		4.75%	-11.71[-22.32,-1.1]
Deering 2011	11	-2.6 (15.6)	14	-1.9 (16.8)		3.51%	-0.78[-13.54,11.98]
Elci 2008	39	-5.2 (16.5)	39	0.8 (16.6)		8.06%	-5.98[-13.33,1.37]
Engström 1999	26	-7.5 (23.5)	24	-4.1 (23)		3.45%	-3.4[-16.29,9.49]
Fernandez 2009	27	-22.8 (20.4)	14	-9.1 (17.3)		3.95%	-13.7[-25.59,-1.81]
Finnerty 2001	24	-18.6 (13.7)	25	-3.8 (21.5)		5.16%	-14.8[-24.85,-4.75]
Gohl 2006	10	-2 (30)	9	2 (38)		0.68%	-4[-35.02,27.02]
Gottlieb 2011	21	-3.1 (20.7)	20	-3.6 (18.6)		3.87%	0.49[-11.54,12.52]
Griffiths 2000	93	-5.5 (22.3)	91	-0.9 (18.8)		10.35%	-4.6[-10.55,1.35]
Gurgun 2013	30	-10.4 (14.8)	16	0.5 (1.1)		11.62%	-10.91[-16.23,-5.59]
Karapolat 2007	26	-22.3 (16.3)	19	-14.2 (24.7)		3.51%	-8.1[-20.85,4.65]
Paz-Diaz 2007	10	-11 (13)	14	-1 (20)		3.31%	-10[-23.22,3.22]
Ringbaek 2000	17	0.7 (22.2)	19	1.1 (24.7)		2.56%	-0.4[-15.72,14.92]
Theander 2009	12	10.6 (22.3)	14	-0.5 (29.3)		1.59%	11.1[-8.77,30.97]
Van Wetering 2010	87	-3 (17.7)	88	-1.4 (16.9)		12.03%	-1.6[-6.73,3.53]
Total ***	**596**		**557**			**100%**	**-5.09[-7.69,-2.49]**
Heterogeneity: Tau^2=7.79; Chi^2=24.31, df=18(P=0.15); I^2=25.95%							
Test for overall effect: Z=3.84(P=0)							



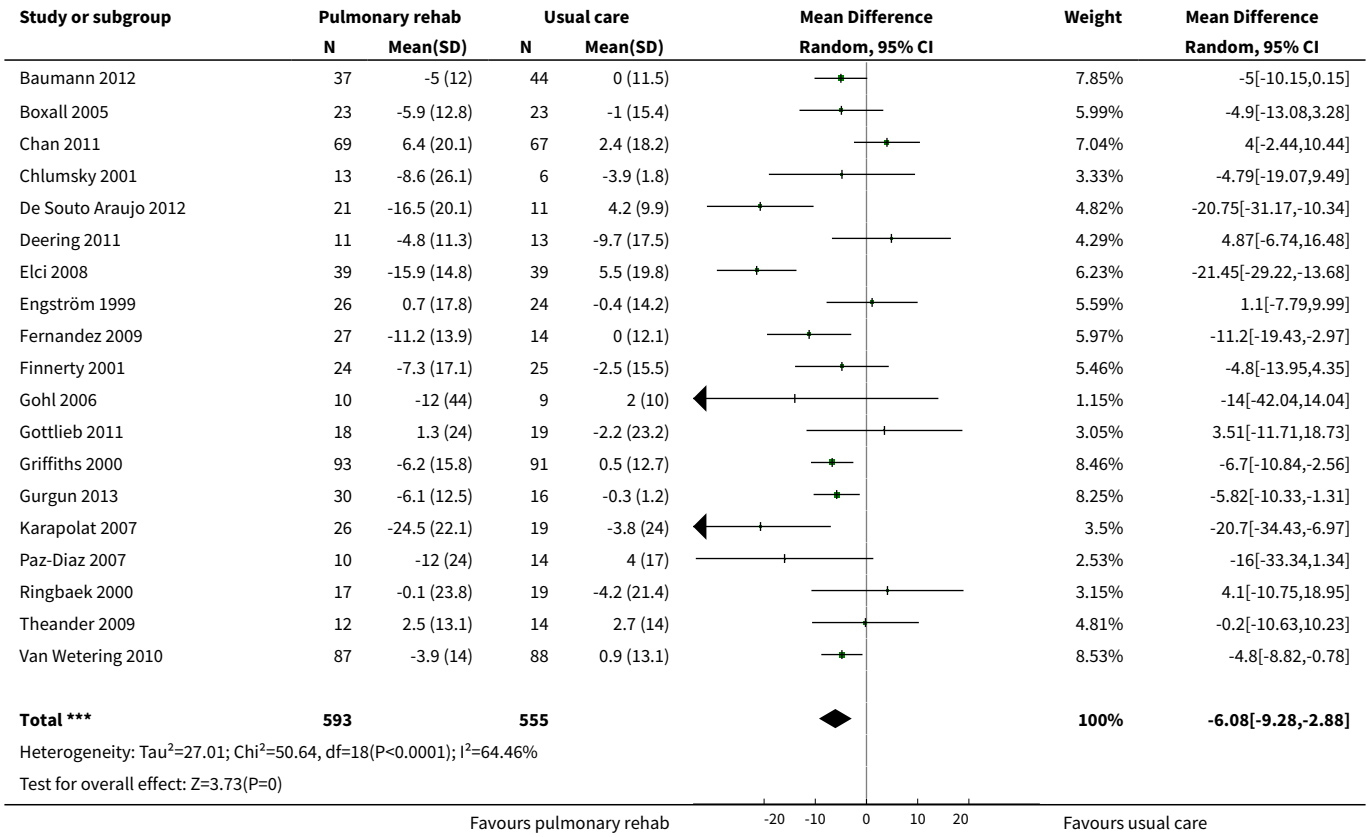
Analysis 1.7. Comparison 1 Rehabilitation versus usual care, Outcome 7 QoL - Change in SGRQ (Impacts).

Study or subgroup	Pulmonary rehab		Usual care		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Random, 95% CI		Random, 95% CI
Baumann 2012	37	-9 (15)	44	-1 (9.9)		7.14%	-8[-13.64,-2.36]
Boxall 2005	23	-8.1 (17.1)	23	-2 (17.6)		4.24%	-6.1[-16.13,3.93]
Chan 2011	69	3.1 (17.8)	67	4.8 (16.7)		7.01%	-1.7[-7.5,4.1]
Chlumsky 2001	13	-4.8 (17.4)	6	-3.8 (4.4)		4.21%	-1.02[-11.12,9.08]
De Souto Araujo 2012	21	-9.8 (13.9)	11	8.2 (10.3)		5.08%	-17.93[-26.46,-9.41]
Deering 2011	11	-6.4 (14.1)	13	10.7 (16.6)		3.28%	-17.14[-29.41,-4.87]
Elci 2008	39	-15.3 (12.9)	39	2.8 (19.9)		5.78%	-18.08[-25.52,-10.64]
Engström 1999	26	2.6 (19.4)	24	2.5 (20.1)		3.8%	0.1[-10.87,11.07]
Fernandez 2009	27	-14.3 (16.3)	14	-1.8 (16.9)		3.89%	-12.5[-23.28,-1.72]
Finnerty 2001	24	-7.6 (15.7)	25	-1.5 (18)		4.55%	-6.1[-15.55,3.35]
Gohl 2006	10	-4 (14)	9	0 (8)		4.19%	-4[-14.13,6.13]
Gottlieb 2011	18	-4.8 (12.8)	20	-0.1 (8.7)		6.07%	-4.69[-11.73,2.35]
Griffiths 2000	93	-8.2 (17.8)	91	2.4 (15.2)		7.84%	-10.6[-15.38,-5.82]
Gurgun 2013	30	-4.7 (10.4)	16	0.1 (1.5)		8.62%	-4.78[-8.59,-0.98]
Karapolat 2007	26	-18.4 (15.1)	19	0 (16.8)		4.5%	-18.4[-27.93,-8.87]
Paz-Diaz 2007	10	-10 (14)	14	-4 (14)		3.63%	-6[-17.36,5.36]
Ringbaek 2000	17	-4 (19.6)	19	-1.9 (18.2)		3.23%	-2.1[-14.5,10.3]
Theander 2009	12	9.7 (15.5)	14	3.4 (10.7)		4.06%	6.3[-4.11,16.71]
Van Wetering 2010	87	-4.1 (11.2)	88	0.5 (12.2)		8.88%	-4.6[-8.07,-1.13]

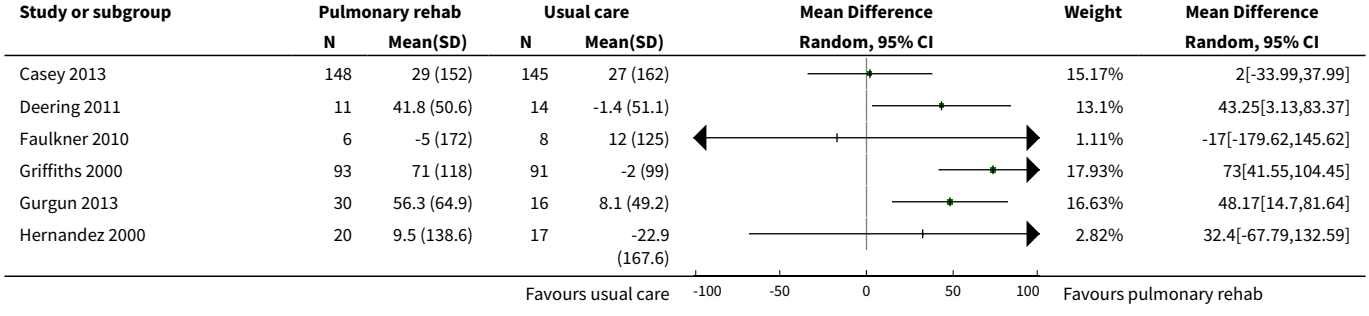


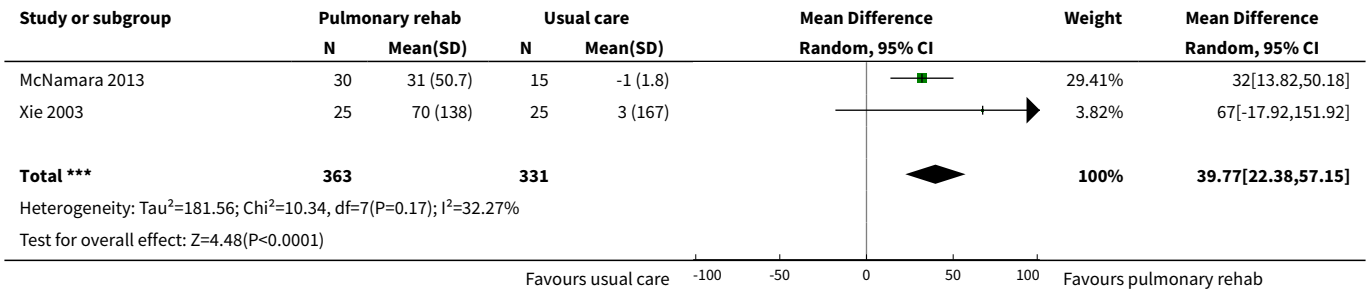


Analysis 1.8. Comparison 1 Rehabilitation versus usual care, Outcome 8 QoL - Change in SGRQ (Activity).

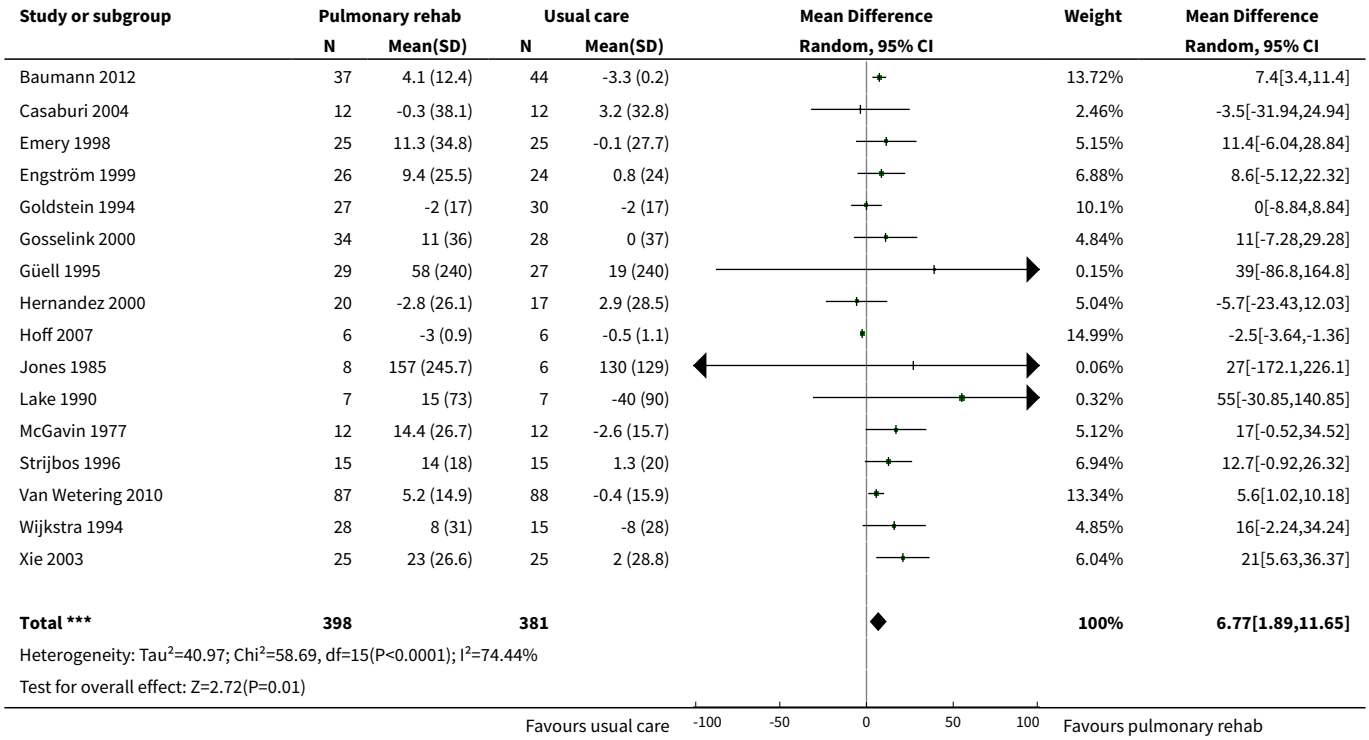


Analysis 1.9. Comparison 1 Rehabilitation versus usual care, Outcome 9 Maximal Exercise (Incremental shuttle walk test).

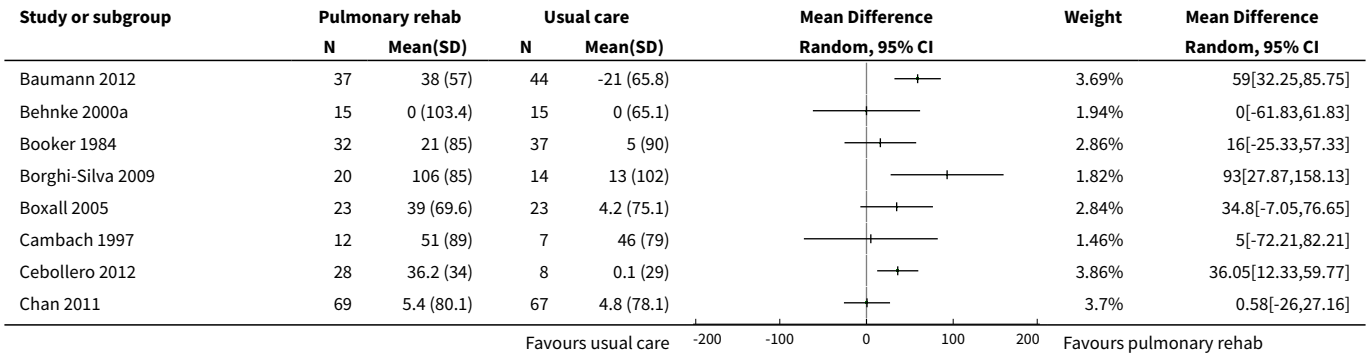


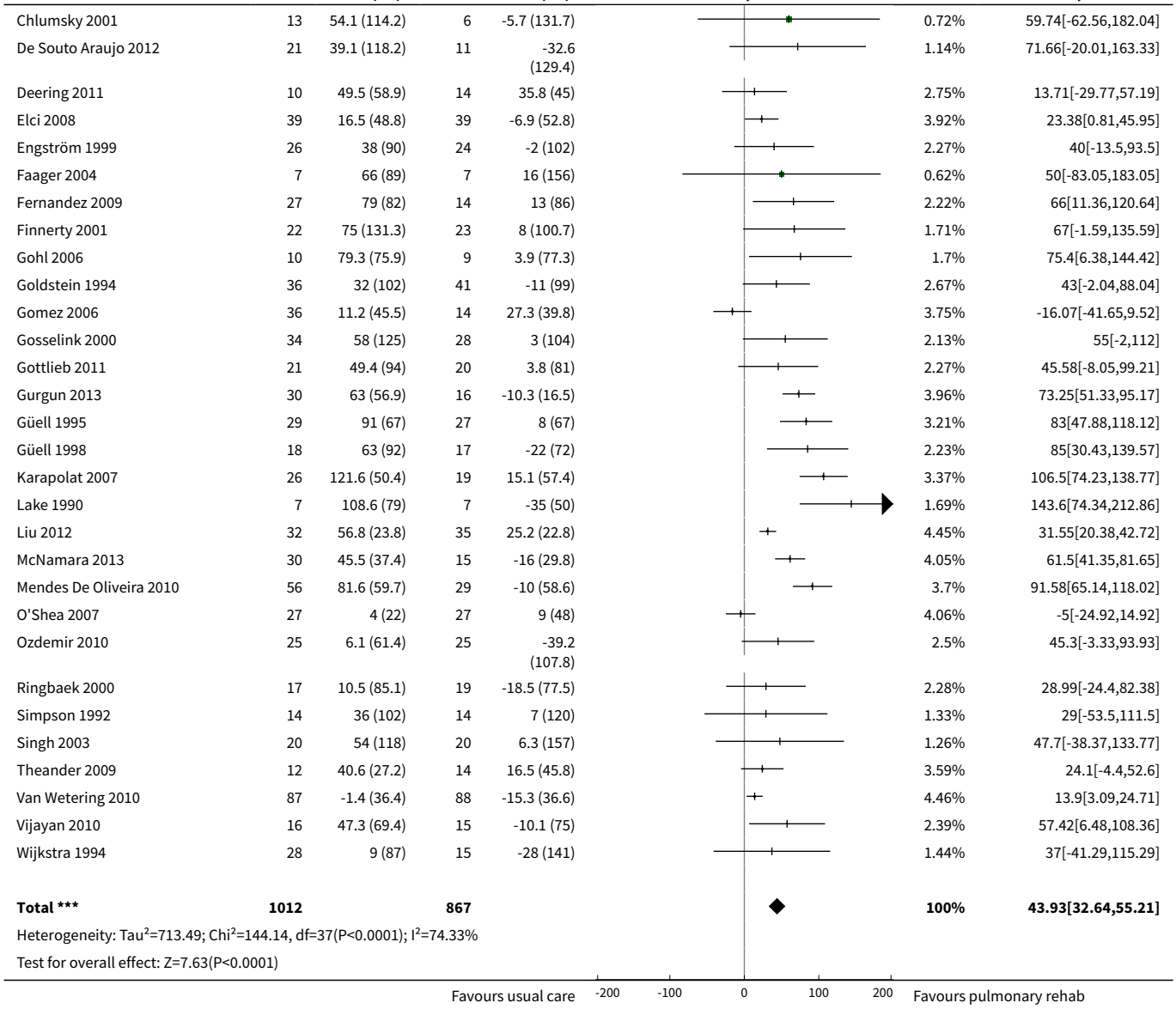


Analysis 1.10. Comparison 1 Rehabilitation versus usual care, Outcome 10 Maximal Exercise Capacity (cycle ergometer).



Analysis 1.11. Comparison 1 Rehabilitation versus usual care, Outcome 11 Functional Exercise Capacity (6MWT)).





Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Chlumsky 2001	13	54.1 (114.2)	6	-5.7 (131.7)		0.72%	59.74[-62.56,182.04]
De Souto Araujo 2012	21	39.1 (118.2)	11	-32.6 (129.4)		1.14%	71.66[-20.01,163.33]
Deering 2011	10	49.5 (58.9)	14	35.8 (45)		2.75%	13.71[-29.77,57.19]
Elci 2008	39	16.5 (48.8)	39	-6.9 (52.8)		3.92%	23.38[0.81,45.95]
Engström 1999	26	38 (90)	24	-2 (102)		2.27%	40[-13.5,93.5]
Faager 2004	7	66 (89)	7	16 (156)		0.62%	50[-83.05,183.05]
Fernandez 2009	27	79 (82)	14	13 (86)		2.22%	66[11.36,120.64]
Finnerty 2001	22	75 (131.3)	23	8 (100.7)		1.71%	67[-1.59,135.59]
Gohl 2006	10	79.3 (75.9)	9	3.9 (77.3)		1.7%	75.4[6.38,144.42]
Goldstein 1994	36	32 (102)	41	-11 (99)		2.67%	43[-2.04,88.04]
Gomez 2006	36	11.2 (45.5)	14	27.3 (39.8)		3.75%	-16.07[-41.65,9.52]
Gosselink 2000	34	58 (125)	28	3 (104)		2.13%	55[-2,112]
Gottlieb 2011	21	49.4 (94)	20	3.8 (81)		2.27%	45.58[-8.05,99.21]
Gurgun 2013	30	63 (56.9)	16	-10.3 (16.5)		3.96%	73.25[51.33,95.17]
Güell 1995	29	91 (67)	27	8 (67)		3.21%	83[47.88,118.12]
Güell 1998	18	63 (92)	17	-22 (72)		2.23%	85[30.43,139.57]
Karapolat 2007	26	121.6 (50.4)	19	15.1 (57.4)		3.37%	106.5[74.23,138.77]
Lake 1990	7	108.6 (79)	7	-35 (50)		1.69%	143.6[74.34,212.86]
Liu 2012	32	56.8 (23.8)	35	25.2 (22.8)		4.45%	31.55[20.38,42.72]
McNamara 2013	30	45.5 (37.4)	15	-16 (29.8)		4.05%	61.5[41.35,81.65]
Mendes De Oliveira 2010	56	81.6 (59.7)	29	-10 (58.6)		3.7%	91.58[65.14,118.02]
O'Shea 2007	27	4 (22)	27	9 (48)		4.06%	-5[-24.92,14.92]
Ozdemir 2010	25	6.1 (61.4)	25	-39.2 (107.8)		2.5%	45.3[-3.33,93.93]
Ringbaek 2000	17	10.5 (85.1)	19	-18.5 (77.5)		2.28%	28.99[-24.4,82.38]
Simpson 1992	14	36 (102)	14	7 (120)		1.33%	29[-53.5,111.5]
Singh 2003	20	54 (118)	20	6.3 (157)		1.26%	47.7[-38.37,133.77]
Theander 2009	12	40.6 (27.2)	14	16.5 (45.8)		3.59%	24.1[-4.4,52.6]
Van Wetering 2010	87	-1.4 (36.4)	88	-15.3 (36.6)		4.46%	13.9[3.09,24.71]
Vijayan 2010	16	47.3 (69.4)	15	-10.1 (75)		2.39%	57.42[6.48,108.36]
Wijkstra 1994	28	9 (87)	15	-28 (141)		1.44%	37[-41.29,115.29]
Total ***	**1012**		**867**			**100%**	**43.93[32.64,55.21]**

Heterogeneity: Tau²=713.49; Chi²=144.14, df=37(P<0.0001); I²=74.33%

Test for overall effect: Z=7.63(P<0.0001)

Comparison 2. Rehabilitation versus usual care (subgroup analysis hospital vs community)

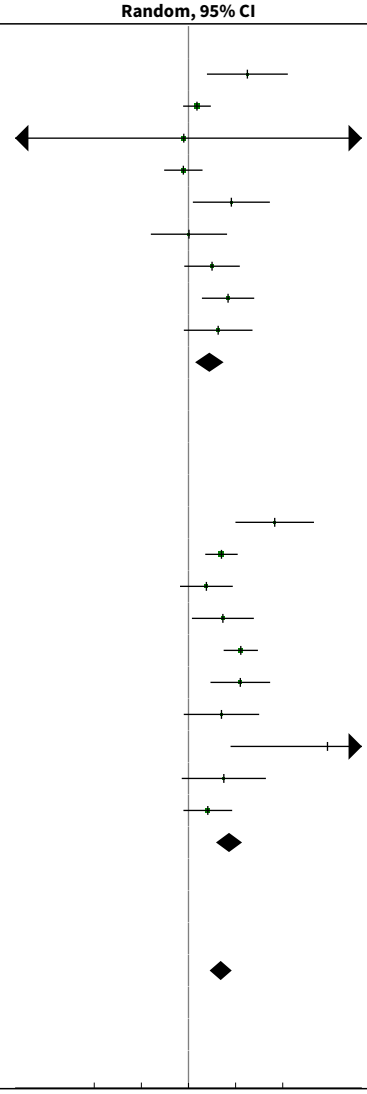
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 QoL - Change in CRQ (Fatigue)	19	1291	Mean Difference (IV, Random, 95% CI)	0.68 [0.45, 0.92]
1.1 QoL - Community CRQ (Fatigue)	9	648	Mean Difference (IV, Random, 95% CI)	0.44 [0.14, 0.75]
1.2 QoL - Hospital CRQ (Fatigue)	10	643	Mean Difference (IV, Random, 95% CI)	0.86 [0.58, 1.14]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2 QoL - Change in CRQ (Emotional Function)	19	1291	Mean Difference (IV, Random, 95% CI)	0.56 [0.34, 0.78]
2.1 QoL - Community (Emotional Function)	9	648	Mean Difference (IV, Random, 95% CI)	0.21 [0.04, 0.39]
2.2 QoL - Hospital CRQ (Emotional Function)	10	643	Mean Difference (IV, Random, 95% CI)	0.77 [0.51, 1.03]
3 QoL - Change in CRQ (Mastery)	19	1212	Mean Difference (IV, Random, 95% CI)	0.71 [0.47, 0.95]
3.1 QoL - Community CRQ (Mastery)	9	569	Mean Difference (IV, Random, 95% CI)	0.40 [0.12, 0.67]
3.2 QoL - Hospital CRQ (Mastery)	10	643	Mean Difference (IV, Random, 95% CI)	0.95 [0.70, 1.20]
4 QoL - Change in CRQ (Dyspnoea)	19	1283	Mean Difference (IV, Random, 95% CI)	0.82 [0.59, 1.05]
4.1 QoL - Community Based CRQ (Dyspnoea)	8	633	Mean Difference (IV, Random, 95% CI)	0.58 [0.34, 0.81]
4.2 QoL - Hospital Based CRQ (Dyspnoea)	11	650	Mean Difference (IV, Random, 95% CI)	0.99 [0.66, 1.32]
5 QoL - Change in SGRQ (Total)	19	1146	Mean Difference (IV, Random, 95% CI)	-6.89 [-9.26, -4.52]
5.1 QoL - Community in SGRQ (Total)	9	643	Mean Difference (IV, Random, 95% CI)	-8.15 [-12.16, -4.13]
5.2 QoL - Hospital SGRQ (Total)	10	503	Mean Difference (IV, Random, 95% CI)	-6.05 [-8.91, -3.20]
6 QoL - Change in SGRQ (Symptoms)	19	1153	Mean Difference (IV, Random, 95% CI)	-5.09 [-7.69, -2.49]
6.1 QoL - Community SGRQ (Symptoms)	9	649	Mean Difference (IV, Random, 95% CI)	-3.66 [-7.07, -0.24]
6.2 QoL - Hospital SGRQ (Symptoms)	10	504	Mean Difference (IV, Random, 95% CI)	-6.91 [-10.51, -3.30]
7 QoL - Change in SGRQ (Impacts)	19	1149	Mean Difference (IV, Random, 95% CI)	-7.23 [-9.91, -4.55]
7.1 QoL - Community SGRQ (Impacts)	9	646	Mean Difference (IV, Random, 95% CI)	-8.17 [-10.00, -4.34]
7.2 QoL - Hospital SGRQ (Impacts)	10	503	Mean Difference (IV, Random, 95% CI)	-6.21 [-10.33, -2.09]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
8 QoL - Change in SGRQ (Activity)	19	1148	Mean Difference (IV, Random, 95% CI)	-6.08 [-9.28, -2.88]
8.1 QoL - Community SGRQ (Activity)	9	645	Mean Difference (IV, Random, 95% CI)	-7.82 [-13.37, -2.28]
8.2 QoL - Hospital SGRQ (Activity)	10	503	Mean Difference (IV, Random, 95% CI)	-4.58 [-8.16, 1.00]

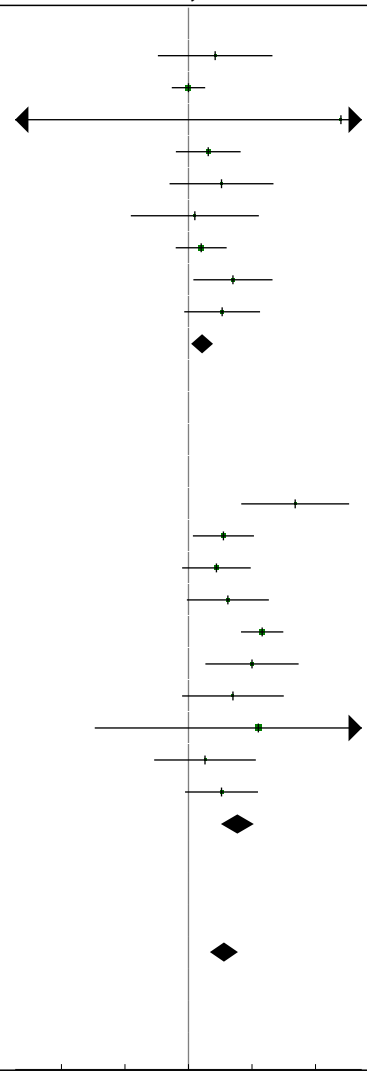
Analysis 2.1. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 1 QoL - Change in CRQ (Fatigue).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
2.1.1 QoL - Community CRQ (Fatigue)							
Cambach 1997	15	1.3 (1)	8	0 (1)		4.2%	1.25[0.39,2.11]
Casey 2013	176	0.5 (1.3)	170	0.3 (1.5)		8.34%	0.18[-0.11,0.47]
Faulkner 2010	6	-0.5 (3.8)	8	-0.4 (5)		0.25%	-0.1[-4.71,4.51]
Gomez 2006	36	0.3 (0.7)	14	0.4 (0.7)		7.44%	-0.11[-0.52,0.3]
Hernandez 2000	20	0.9 (1.5)	17	0 (1.1)		4.43%	0.91[0.09,1.73]
Lindsay 2005	21	0.4 (1.3)	20	0.4 (1.3)		4.48%	0.01[-0.8,0.82]
O'Shea 2007	27	0.4 (1.2)	27	-0.1 (1)		5.98%	0.5[-0.09,1.09]
Singh 2003	20	0.9 (0.9)	20	0.1 (0.9)		6.24%	0.84[0.29,1.39]
Wijkstra 1994	28	0.9 (1.3)	15	0.3 (1.1)		4.98%	0.63[-0.1,1.36]
Subtotal ***	**349**		**299**			**46.35%**	**0.44[0.14,0.75]**
Heterogeneity: Tau^2=0.1; Chi^2=16.68, df=8(P=0.03); I^2=52.03%							
Test for overall effect: Z=2.87(P=0)							
2.1.2 QoL - Hospital CRQ (Fatigue)							
Behnke 2000a	15	1.6 (0.8)	15	-0.2 (1.5)		4.34%	1.83[1,2.66]
Cebollero 2012	28	0.7 (0.9)	8	0 (0.2)		7.95%	0.7[0.36,1.04]
Goldstein 1994	40	0.1 (1.2)	40	-0.3 (1.4)		6.2%	0.38[-0.18,0.94]
Gosselink 2000	34	0.6 (1.2)	28	-0.1 (1.4)		5.47%	0.73[0.07,1.39]
Griffiths 2000	93	1 (1.4)	91	-0.1 (1.1)		7.8%	1.11[0.75,1.47]
Güell 1995	29	0.8 (1.1)	27	-0.3 (1.3)		5.65%	1.1[0.47,1.73]
Güell 1998	18	0.2 (1.1)	17	-0.5 (1.3)		4.53%	0.7[-0.1,1.5]
McNamara 2013	30	2.4 (3.5)	15	-0.6 (3.3)		1.14%	2.95[0.89,5.01]
Simpson 1992	14	1 (1.2)	14	0.3 (1.2)		4.01%	0.75[-0.14,1.64]
Sridhar 2008	47	0.1 (1.4)	40	-0.3 (1.1)		6.54%	0.41[-0.11,0.93]
Subtotal ***	**348**		**295**			**53.65%**	**0.86[0.58,1.14]**
Heterogeneity: Tau^2=0.09; Chi^2=18.38, df=9(P=0.03); I^2=51.03%							
Test for overall effect: Z=6.09(P<0.0001)							
Total ***	**697**		**594**			**100%**	**0.68[0.45,0.92]**
Heterogeneity: Tau^2=0.15; Chi^2=50.32, df=18(P<0.0001); I^2=64.23%							
Test for overall effect: Z=5.71(P<0.0001)							
Test for subgroup differences: Chi^2=3.98, df=1 (P=0.05), I^2=74.88%							



Analysis 2.2. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 2 QoL - Change in CRQ (Emotional Function).

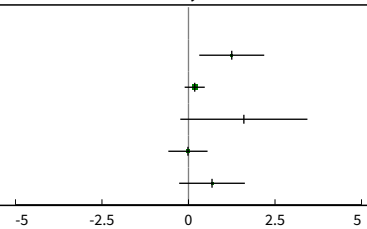
Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
2.2.1 QoL - Community (Emotional Function)							
Cambach 1997	15	0.7 (1.1)	8	0.3 (1)		3.84%	0.42[-0.48,1.32]
Casey 2013	176	0.2 (1.2)	170	0.2 (1.3)		9.28%	0[-0.26,0.26]
Faulkner 2010	6	-0.2 (3.7)	8	-2.6 (6.8)		0.15%	2.4[-3.16,7.96]
Gomez 2006	36	0.8 (0.8)	14	0.5 (0.8)		6.81%	0.31[-0.2,0.82]
Hernandez 2000	20	0.8 (1.2)	17	0.3 (1.3)		4.33%	0.52[-0.3,1.34]
Lindsay 2005	21	0.4 (1.9)	20	0.3 (1.4)		3.31%	0.1[-0.91,1.11]
O'Shea 2007	27	0.4 (0.8)	27	0.2 (0.7)		7.9%	0.2[-0.2,0.6]
Singh 2003	20	0.9 (1.1)	20	0.2 (0.9)		5.77%	0.7[0.08,1.32]
Wijkstra 1994	28	0.6 (1)	15	0 (0.9)		6%	0.53[-0.07,1.13]
Subtotal ***	**349**		**299**			**47.39%**	**0.21[0.04,0.39]**
Heterogeneity: Tau^2=0; Chi^2=7.49, df=8(P=0.49); I^2=0%							
Test for overall effect: Z=2.43(P=0.01)							
2.2.2 QoL - Hospital CRQ (Emotional Function)							
Behnke 2000a	15	1.5 (0.9)	15	-0.2 (1.4)		4.14%	1.68[0.83,2.53]
Cebollero 2012	28	0.7 (0.7)	8	0.1 (0.6)		7.09%	0.55[0.07,1.03]
Goldstein 1994	40	0.2 (1.2)	40	-0.2 (1.3)		6.52%	0.44[-0.1,0.98]
Gosselink 2000	34	0.5 (1.2)	28	-0.1 (1.3)		5.58%	0.62[-0.03,1.27]
Griffiths 2000	93	1 (1.1)	91	-0.2 (1.2)		8.6%	1.16[0.83,1.49]
Güell 1995	29	0.9 (1.4)	27	-0.1 (1.4)		4.9%	1[0.27,1.73]
Güell 1998	18	0.2 (1.1)	17	-0.5 (1.3)		4.44%	0.7[-0.1,1.5]
McNamara 2013	30	1.8 (4.5)	15	0.7 (4)		0.69%	1.1[-1.48,3.68]
Simpson 1992	14	0.4 (1.1)	14	0.1 (1.1)		4.44%	0.26[-0.54,1.06]
Sridhar 2008	47	0.2 (1.4)	40	-0.4 (1.3)		6.2%	0.52[-0.05,1.09]
Subtotal ***	**348**		**295**			**52.61%**	**0.77[0.51,1.03]**
Heterogeneity: Tau^2=0.06; Chi^2=14.72, df=9(P=0.1); I^2=38.85%							
Test for overall effect: Z=5.82(P<0.0001)							
Total ***	**697**		**594**			**100%**	**0.56[0.34,0.78]**
Heterogeneity: Tau^2=0.12; Chi^2=43.36, df=18(P=0); I^2=58.49%							
Test for overall effect: Z=4.96(P<0.0001)							
Test for subgroup differences: Chi^2=12.24, df=1 (P=0), I^2=91.83%							



Favours usual care — Favours pulmonary rehab

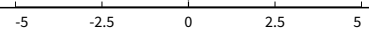
Analysis 2.3. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 3 QoL - Change in CRQ (Mastery).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
2.3.1 QoL - Community CRQ (Mastery)							
Cambach 1997	15	1 (1.3)	8	-0.2 (1)		3.87%	1.25[0.31,2.19]
Casey 2013	135	0.5 (1.1)	132	0.3 (1.3)		8.39%	0.18[-0.11,0.47]
Faulkner 2010	6	1.2 (1.6)	8	-0.4 (1.9)		1.44%	1.6[-0.24,3.44]
Gomez 2006	36	-0.6 (1)	14	-0.6 (0.9)		6.23%	-0.02[-0.58,0.55]
Hernandez 2000	20	0.6 (1.3)	17	-0 (1.6)		3.82%	0.68[-0.27,1.63]



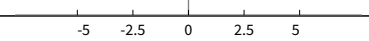
Favours usual care — Favours pulmonary rehab

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Lindsay 2005	21	0.3 (1.2)	20	0.3 (1.3)		4.81%	0[-0.77,0.77]
O'Shea 2007	27	0.3 (0.8)	27	0.2 (0.8)		7.33%	0.1[-0.33,0.53]
Singh 2003	20	0.9 (0.9)	20	0.1 (0.8)		6.53%	0.84[0.31,1.37]
Wijkstra 1994	28	0.6 (1.2)	15	0 (1)		5.36%	0.6[-0.09,1.29]
Subtotal * **	**308**		**261**			**47.77%**	**0.4[0.12,0.67]**
Heterogeneity: Tau^2=0.07; Chi^2=14.49, df=8(P=0.07); I^2=44.78%							
Test for overall effect: Z=2.79(P=0.01)							
2.3.2 QoL - Hospital CRQ (Mastery)							
Behnke 2000a	15	2.1 (0.6)	15	-0.1 (1.5)		4.68%	2.15[1.36,2.94]
Cebollero 2012	28	0.6 (0.8)	8	-0.1 (0.5)		7.19%	0.7[0.26,1.14]
Goldstein 1994	40	0.7 (1.1)	40	-0.1 (1.4)		6.24%	0.76[0.2,1.32]
Gosselink 2000	34	0.7 (1.4)	28	-0.2 (1.6)		4.94%	0.91[0.16,1.66]
Griffiths 2000	93	1 (1.3)	91	-0.1 (1.3)		7.8%	1.05[0.68,1.42]
Güell 1995	29	1 (1.2)	27	-0.2 (1.5)		5.16%	1.2[0.49,1.91]
Güell 1998	18	0.6 (1.1)	17	0 (1.1)		5.06%	0.6[-0.13,1.33]
McNamara 2013	30	1.5 (2.9)	15	0.3 (2.3)		1.92%	1.15[-0.39,2.69]
Simpson 1992	14	0.9 (1.7)	14	0.1 (1.3)		3.19%	0.72[-0.37,1.81]
Sridhar 2008	47	0.4 (1.3)	40	-0.3 (1.5)		6.06%	0.7[0.11,1.29]
Subtotal * **	**348**		**295**			**52.23%**	**0.95[0.7,1.2]**
Heterogeneity: Tau^2=0.05; Chi^2=13.07, df=9(P=0.16); I^2=31.16%							
Test for overall effect: Z=7.53(P<0.0001)							
Total * **	**656**		**556**			**100%**	**0.71[0.47,0.95]**
Heterogeneity: Tau^2=0.16; Chi^2=49, df=18(P=0); I^2=63.26%							
Test for overall effect: Z=5.82(P<0.0001)							
Test for subgroup differences: Chi^2=8.58, df=1 (P=0), I^2=88.35%							

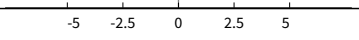


Analysis 2.4. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 4 QoL - Change in CRQ (Dyspnoea).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
2.4.1 QoL - Community Based CRQ (Dyspnoea)							
Cambach 1997	14	1.2 (1.2)	8	0 (0.8)		4.27%	1.2[0.36,2.04]
Casey 2013	176	0.7 (1.4)	170	0.4 (1.5)		8.51%	0.28[-0.02,0.58]
Gomez 2006	36	0 (0.8)	14	-0.5 (0.7)		7.16%	0.52[0.07,0.97]
Hernandez 2000	20	1.1 (1.1)	17	0.3 (1.2)		4.76%	0.78[0.02,1.54]
Lindsay 2005	21	1.2 (1.3)	20	1.1 (1.3)		4.5%	0.06[-0.74,0.86]
O'Shea 2007	27	0.6 (1.5)	27	0 (1)		5.3%	0.6[-0.08,1.28]
Singh 2003	20	1 (0.9)	20	0.1 (0.8)		6.46%	0.88[0.35,1.41]
Wijkstra 1994	28	0.9 (1)	15	-0 (1.3)		4.7%	0.9[0.13,1.67]
Subtotal * **	**342**		**291**			**45.65%**	**0.58[0.34,0.81]**
Heterogeneity: Tau^2=0.03; Chi^2=9.52, df=7(P=0.22); I^2=26.45%							
Test for overall effect: Z=4.76(P<0.0001)							
2.4.2 QoL - Hospital Based CRQ (Dyspnoea)							
Behnke 2000a	15	2.4 (1.2)	15	0.2 (1.3)		3.84%	2.26[1.34,3.18]



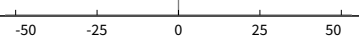
Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Cebollero 2012	28	0.9 (0.9)	8	0.1 (0.8)		5.62%	0.8[0.16,1.44]
Faulkner 2010	7	0.6 (1.3)	7	0.2 (1.3)		2.19%	0.4[-0.97,1.77]
Goldstein 1994	40	0.7 (1.1)	39	0 (1.3)		6.4%	0.66[0.12,1.2]
Gosselink 2000	34	0.8 (1.3)	28	-0 (1.3)		5.51%	0.82[0.17,1.47]
Griffiths 2000	93	1 (1.3)	91	-0.2 (1)		8.22%	1.18[0.85,1.51]
Güell 1995	29	1.2 (1.4)	27	-0.1 (1.1)		5.47%	1.3[0.64,1.96]
Güell 1998	18	0.8 (1.2)	17	-0.2 (1.2)		4.52%	1[0.2,1.8]
McNamara 2013	30	2.2 (3.8)	15	0 (1.8)		1.64%	2.15[0.52,3.78]
Simpson 1992	12	1.2 (1.1)	10	0 (0.8)		4.32%	1.2[0.37,2.03]
Sridhar 2008	47	-0.7 (1.2)	40	-0.8 (1.2)		6.62%	0.12[-0.39,0.63]
Subtotal ***	**353**		**297**			**54.35%**	**0.99[0.66,1.32]**
Heterogeneity: Tau²=0.17; Chi²=25.3, df=10(P=0); I²=60.47%							
Test for overall effect: Z=5.92(P<0.0001)							
Total ***	**695**		**588**			**100%**	**0.82[0.59,1.05]**
Heterogeneity: Tau²=0.14; Chi²=45.25, df=18(P=0); I²=60.22%							
Test for overall effect: Z=7(P<0.0001)							
Test for subgroup differences: Chi²=4.05, df=1 (P=0.04), I²=75.32%							



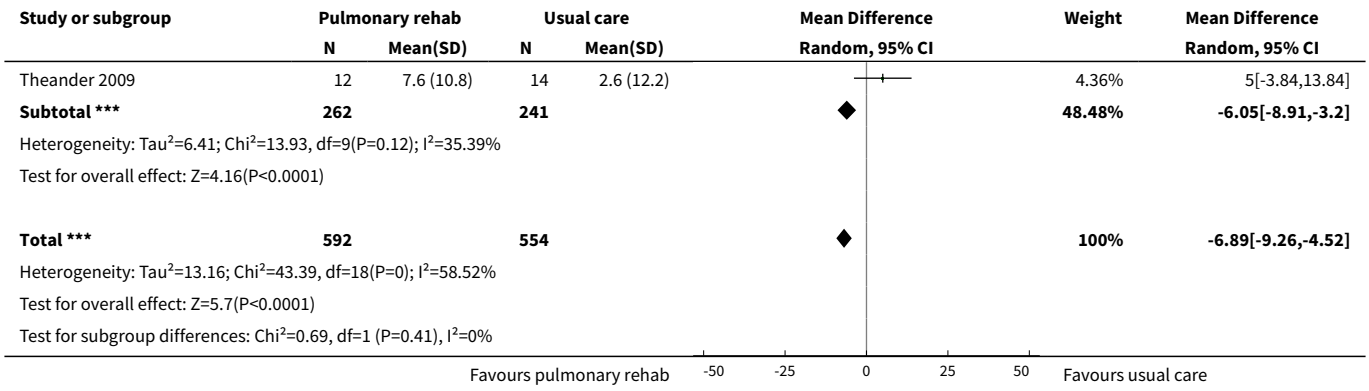
Favours usual care — Favours pulmonary rehab

Analysis 2.5. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 5 QoL - Change in SGRQ (Total).

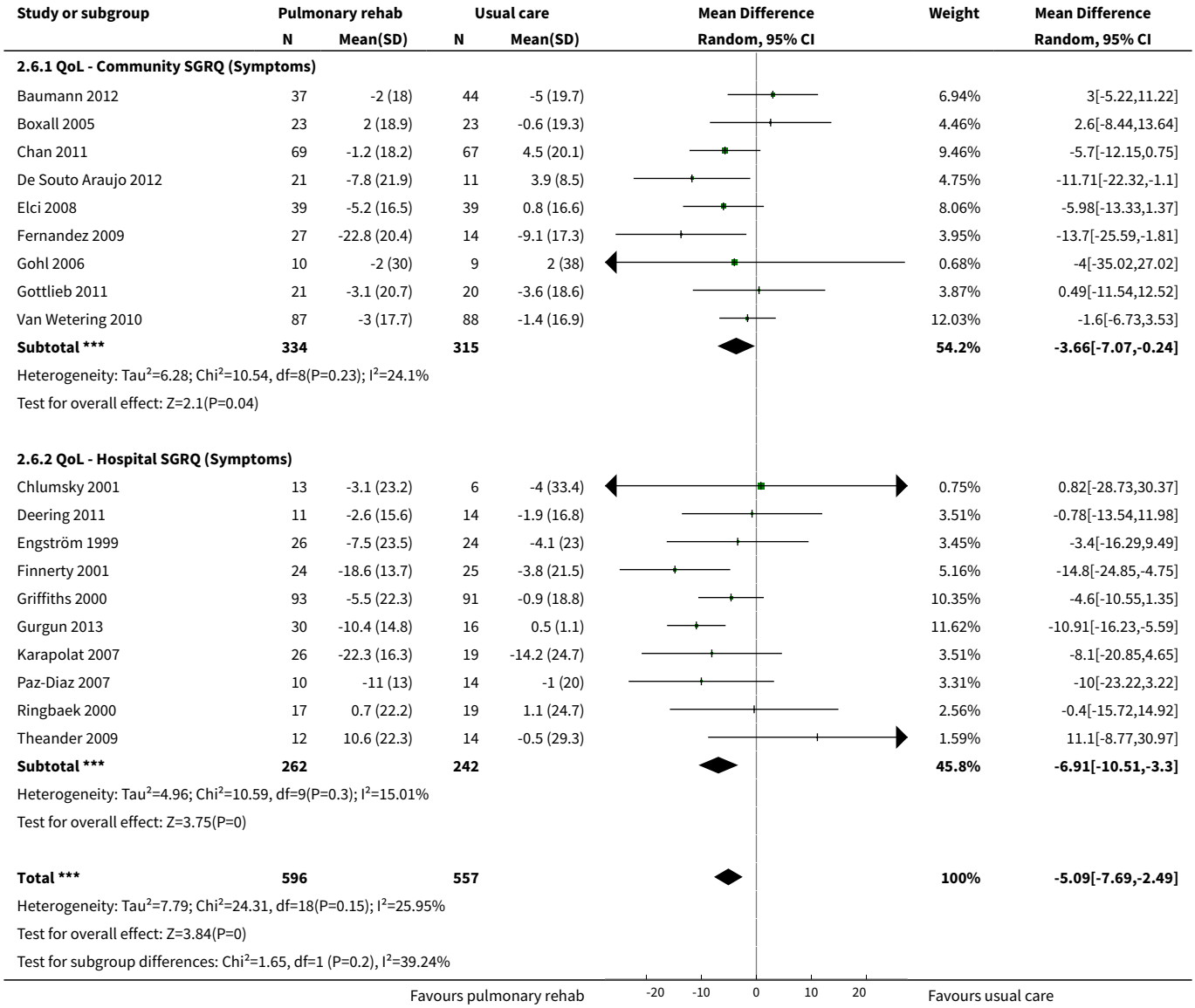
Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
2.5.1 QoL - Community in SGRQ (Total)							
Baumann 2012	37	-7 (10.5)	44	-1 (8.2)		8.28%	-6[-10.16,-1.84]
Boxall 2005	23	-5.8 (11.8)	23	-1.4 (13.3)		5.43%	-4.4[-11.67,2.87]
Chan 2011	69	3.4 (16.1)	67	4 (14.8)		7.24%	-0.6[-5.8,4.6]
De Souto Araujo 2012	21	-11.5 (14.5)	11	6.5 (8.8)		4.84%	-17.94[-26.04,-9.85]
Elci 2008	39	-14.4 (11.6)	39	3.8 (17.4)		6%	-18.2[-24.76,-11.64]
Fernandez 2009	27	-14.7 (13.8)	14	-2.5 (12.7)		4.61%	-12.2[-20.65,-3.75]
Gohl 2006	10	-7.3 (25)	9	2 (24)		1.05%	-9.3[-31.34,12.74]
Gottlieb 2011	17	-5.2 (14.2)	18	0.4 (11.3)		4.55%	-5.62[-14.15,2.91]
Van Wetering 2010	87	-3.9 (10.3)	88	0.3 (9.4)		9.51%	-4.2[-7.11,-1.29]
Subtotal ***	**330**		**313**			**51.52%**	**-8.15[-12.16,-4.13]**
Heterogeneity: Tau²=24; Chi²=29.46, df=8(P=0); I²=72.85%							
Test for overall effect: Z=3.98(P<0.0001)							
2.5.2 QoL - Hospital SGRQ (Total)							
Chlumsky 2001	13	-4.1 (19.8)	6	-4.2 (19.2)		1.4%	0.15[-18.6,18.9]
Deering 2011	11	-6.2 (8.6)	13	3.9 (9.4)		5.46%	-10.03[-17.27,-2.79]
Engström 1999	26	0.3 (17.3)	24	0.5 (16.2)		4.11%	-0.2[-9.49,9.09]
Finnerty 2001	24	-9.3 (12.2)	25	-2.2 (15)		5.16%	-7.1[-14.74,0.54]
Griffiths 2000	93	-7.1 (15.5)	91	1.3 (11.7)		8.48%	-8.4[-12.36,-4.44]
Gurgun 2013	30	-6.4 (8.1)	16	-0.2 (0.7)		9.52%	-6.27[-9.18,-3.36]
Karapolat 2007	26	-16.8 (15.2)	19	-3.7 (17.3)		3.87%	-13.1[-22.83,-3.37]
Paz-Diaz 2007	10	-7 (12)	14	3 (16)		3.19%	-10[-21.21,1.21]
Ringbaek 2000	17	-2.1 (19)	19	-2.2 (17)		2.95%	0.1[-11.73,11.93]



Favours pulmonary rehab — Favours usual care

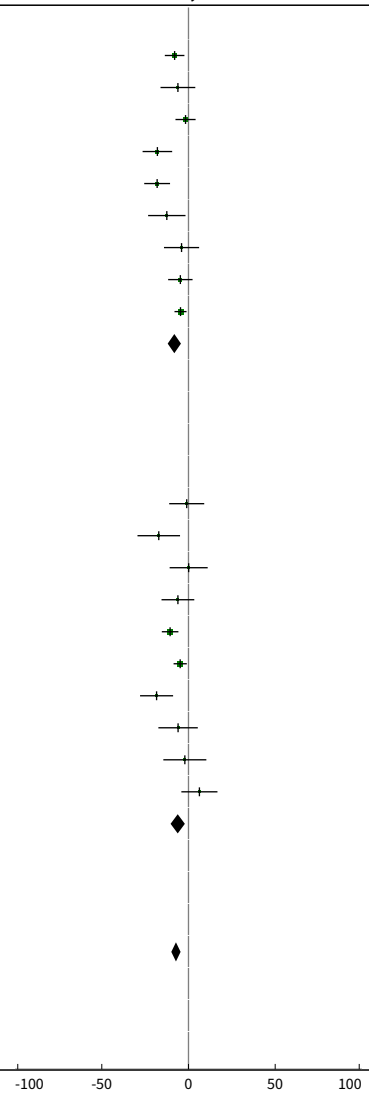


Analysis 2.6. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 6 QoL - Change in SGRQ (Symptoms).



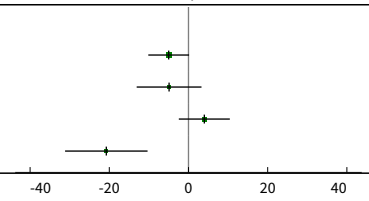
Analysis 2.7. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 7 QoL - Change in SGRQ (Impacts).

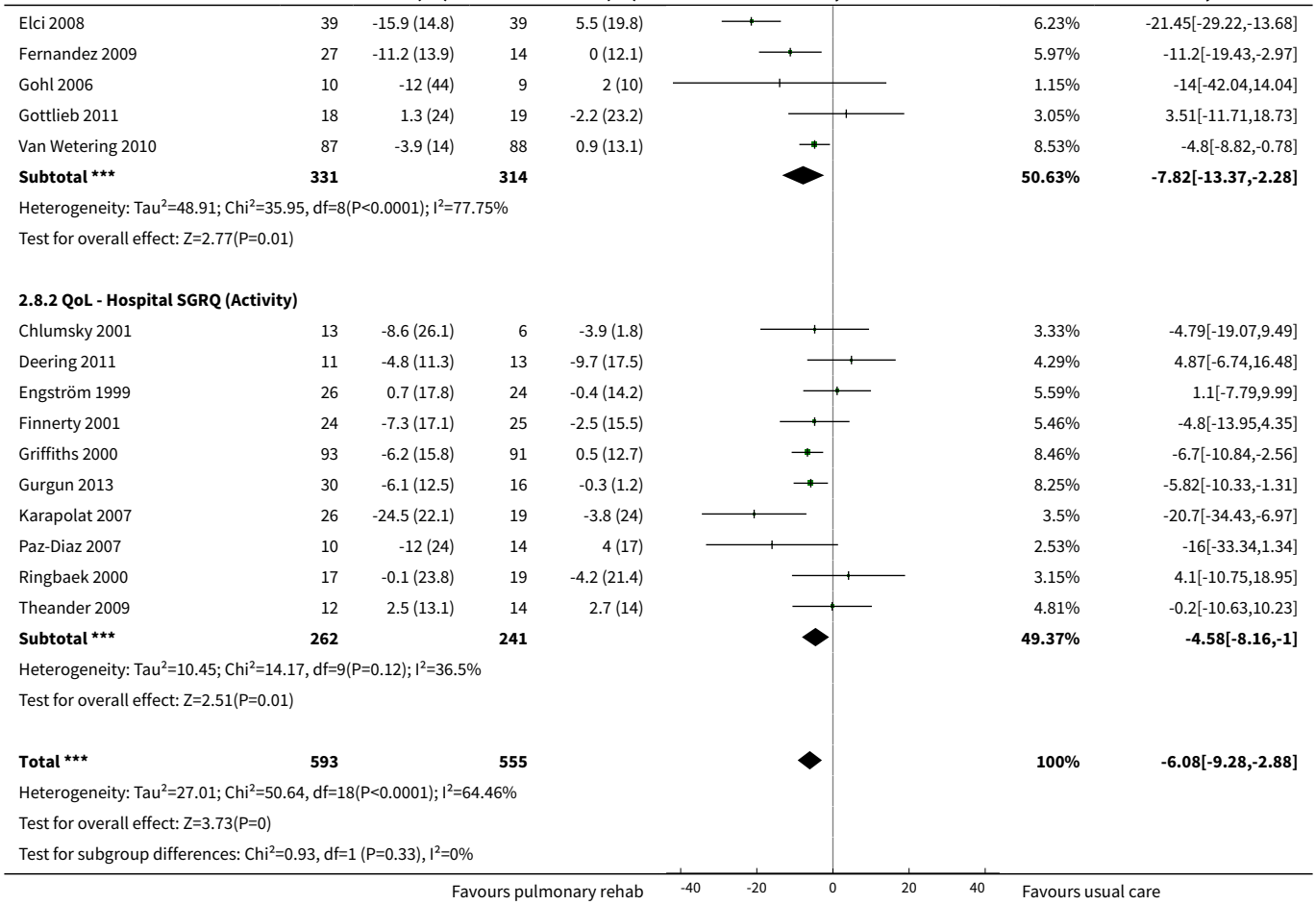
Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
2.7.1 QoL - Community SGRQ (Impacts)							
Baumann 2012	37	-9 (15)	44	-1 (9.9)		7.13%	-8[-13.65,-2.35]
Boxall 2005	23	-8.1 (17.1)	23	-2 (17.6)		4.24%	-6.1[-16.13,3.93]
Chan 2011	69	3.1 (17.8)	67	4.8 (16.7)		7.01%	-1.7[-7.5,4.1]
De Souto Araujo 2012	21	-9.8 (13.9)	11	8.2 (10.3)		5.08%	-17.93[-26.46,-9.41]
Elci 2008	39	-15.3 (12.9)	39	2.8 (19.9)		5.78%	-18.08[-25.52,-10.64]
Fernandez 2009	27	-14.3 (16.3)	14	-1.8 (16.9)		3.89%	-12.5[-23.28,-1.72]
Gohl 2006	10	-4 (14)	9	0 (8)		4.19%	-4[-14.13,6.13]
Gottlieb 2011	18	-4.8 (12.8)	20	-0.1 (8.7)		6.07%	-4.69[-11.73,2.35]
Van Wetering 2010	87	-4.1 (11.2)	88	0.5 (12.2)		8.89%	-4.6[-8.07,-1.13]
Subtotal ***	**331**		**315**			**52.29%**	**-8.17[-12,-4.34]**
Heterogeneity: Tau²=19.91; Chi²=21.78, df=8(P=0.01); I²=63.27%							
Test for overall effect: Z=4.18(P<0.0001)							
2.7.2 QoL - Hospital SGRQ (Impacts)							
Chlumsky 2001	13	-4.8 (17.4)	6	-3.8 (4.4)		4.21%	-1.02[-11.12,9.08]
Deering 2011	11	-6.4 (14.1)	13	10.7 (16.6)		3.28%	-17.14[-29.41,-4.87]
Engström 1999	26	2.6 (19.4)	24	2.5 (20.1)		3.8%	0.1[-10.87,11.07]
Finnerty 2001	24	-7.6 (15.7)	25	-1.5 (18)		4.55%	-6.1[-15.55,3.35]
Griffiths 2000	93	-8.2 (17.8)	91	2.4 (15.2)		7.84%	-10.6[-15.38,-5.82]
Gurgun 2013	30	-4.7 (10.4)	16	0.1 (1.5)		8.62%	-4.78[-8.59,-0.98]
Karapolat 2007	26	-18.4 (15.1)	19	0 (16.8)		4.5%	-18.4[-27.93,-8.87]
Paz-Diaz 2007	10	-10 (14)	14	-4 (14)		3.63%	-6[-17.36,5.36]
Ringbaek 2000	17	-4 (19.6)	19	-1.9 (18.2)		3.23%	-2.1[-14.5,10.3]
Theander 2009	12	9.7 (15.5)	14	3.4 (10.7)		4.06%	6.3[-4.11,16.71]
Subtotal ***	**262**		**241**			**47.71%**	**-6.21[-10.33,-2.09]**
Heterogeneity: Tau²=22.39; Chi²=21.32, df=9(P=0.01); I²=57.79%							
Test for overall effect: Z=2.95(P=0)							
Total ***	**593**		**556**			**100%**	**-7.23[-9.91,-4.55]**
Heterogeneity: Tau²=17.94; Chi²=43.18, df=18(P=0); I²=58.31%							
Test for overall effect: Z=5.29(P<0.0001)							
Test for subgroup differences: Chi²=0.46, df=1 (P=0.5), I²=0%							



Analysis 2.8. Comparison 2 Rehabilitation versus usual care (subgroup analysis hospital vs community), Outcome 8 QoL - Change in SGRQ (Activity).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
2.8.1 QoL - Community SGRQ (Activity)							
Baumann 2012	37	-5 (12)	44	0 (11.5)		7.85%	-5[-10.15,0.15]
Boxall 2005	23	-5.9 (12.8)	23	-1 (15.4)		5.99%	-4.9[-13.08,3.28]
Chan 2011	69	6.4 (20.1)	67	2.4 (18.2)		7.04%	4[-2.44,10.44]
De Souto Araujo 2012	21	-16.5 (20.1)	11	4.2 (9.9)		4.82%	-20.75[-31.17,-10.34]





Comparison 3. Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other)

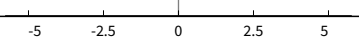
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 QoL - Change in CRQ (Fatigue)	19	1291	Mean Difference (IV, Random, 95% CI)	0.68 [0.45, 0.92]
1.1 QoL - Exercise Only CRQ (Fatigue)	10	480	Mean Difference (IV, Random, 95% CI)	0.73 [0.54, 0.92]
1.2 QoL - Exercise + Other CRQ (Fatigue)	9	811	Mean Difference (IV, Random, 95% CI)	0.61 [0.18, 1.03]
2 QoL - Change in CRQ (Emotional Function)	19	1291	Mean Difference (IV, Random, 95% CI)	0.56 [0.34, 0.78]
2.1 QoL - Exercise Only CRQ (Emotional Function)	10	480	Mean Difference (IV, Random, 95% CI)	0.51 [0.31, 0.71]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.2 QoL - Exercise + Other CRQ (Emotional Function)	9	811	Mean Difference (IV, Random, 95% CI)	0.58 [0.16, 1.00]
3 QoL - Change in CRQ (Mastery)	19	1212	Mean Difference (IV, Random, 95% CI)	0.71 [0.47, 0.95]
3.1 QoL - Exercise Only CRQ (Mastery)	10	480	Mean Difference (IV, Random, 95% CI)	0.66 [0.44, 0.88]
3.2 QoL - Exercise + Other CRQ (Mastery)	9	732	Mean Difference (IV, Random, 95% CI)	0.74 [0.31, 1.18]
4 QoL - Change in CRQ (Dyspnoea)	19	1283	Mean Difference (IV, Random, 95% CI)	0.79 [0.56, 1.03]
4.1 QoL - Exercise Only CRQ (Dyspnoea)	10	474	Mean Difference (IV, Random, 95% CI)	0.83 [0.56, 1.09]
4.2 QoL - Exercise + Other CRQ (Dyspnoea)	9	809	Mean Difference (IV, Random, 95% CI)	0.74 [0.35, 1.13]
5 QoL - Change in SGRQ (Total)	19	1146	Mean Difference (IV, Random, 95% CI)	-6.89 [-9.26, -4.52]
5.1 QoL Exercise Only SGRQ (Total)	5	230	Mean Difference (IV, Random, 95% CI)	-7.87 [-16.72, 0.98]
5.2 QoL Exercise + Other SGRQ (Total)	14	916	Mean Difference (IV, Random, 95% CI)	-6.76 [-9.19, -4.34]
6 QoL - Change in SGRQ (Symptoms)	19	1153	Mean Difference (IV, Random, 95% CI)	-5.09 [-7.69, -2.49]
6.1 QoL - Exercise Only SGRQ (Symptoms)	5	230	Mean Difference (IV, Random, 95% CI)	-7.38 [-12.33, -2.44]
6.2 QoL - Exercise + Other SGRQ (Symptoms)	14	923	Mean Difference (IV, Random, 95% CI)	-4.38 [-7.62, -1.15]
7 QoL - Change in SGRQ (Impacts)	19	1149	Mean Difference (IV, Random, 95% CI)	-7.23 [-9.91, -4.55]
7.1 QoL - Exercise Only SGRQ (Impacts)	5	230	Mean Difference (IV, Random, 95% CI)	-6.11 [-12.60, 0.38]
7.2 QoL - Exercise + Other SGRQ (Impacts)	14	919	Mean Difference (IV, Random, 95% CI)	-7.61 [-10.64, -4.57]
8 QoL - Change in SGRQ (Activity)	19	1148	Mean Difference (IV, Random, 95% CI)	-6.08 [-9.28, -2.88]
8.1 QoL - Exercise Only SGRQ (Activity)	5	230	Mean Difference (IV, Random, 95% CI)	-9.33 [-21.66, 2.99]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
8.2 QoL - Exercise + Other SGRQ (Activity)	14	918	Mean Difference (IV, Random, 95% CI)	-5.79 [-8.95, -2.64]

Analysis 3.1. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 1 QoL - Change in CRQ (Fatigue).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
3.1.1 QoL - Exercise Only CRQ (Fatigue)							
Cebollero 2012	28	0.7 (0.9)	8	0 (0.2)		7.95%	0.7[0.36,1.04]
Gosselink 2000	34	0.6 (1.2)	28	-0.1 (1.4)		5.47%	0.73[0.07,1.39]
Güell 1995	29	0.8 (1.1)	27	-0.3 (1.3)		5.65%	1.1[0.47,1.73]
Güell 1998	18	0.2 (1.1)	17	-0.5 (1.3)		4.53%	0.7[-0.1,1.5]
Hernandez 2000	20	0.9 (1.5)	17	0 (1.1)		4.43%	0.91[0.09,1.73]
McNamara 2013	30	2.4 (3.5)	15	-0.6 (3.3)		1.14%	2.95[0.89,5.01]
O'Shea 2007	27	0.4 (1.2)	27	-0.1 (1)		5.98%	0.5[-0.09,1.09]
Simpson 1992	14	1 (1.2)	14	0.3 (1.2)		4.01%	0.75[-0.14,1.64]
Singh 2003	20	0.9 (0.9)	20	0.1 (0.9)		6.24%	0.84[0.29,1.39]
Sridhar 2008	47	0.1 (1.4)	40	-0.3 (1.1)		6.54%	0.41[-0.11,0.93]
Subtotal ***	**267**		**213**			**51.96%**	**0.73[0.54,0.92]**
Heterogeneity: Tau^2=0; Chi^2=8.22, df=9(P=0.51); I^2=0%							
Test for overall effect: Z=7.51(P<0.0001)							
3.1.2 QoL - Exercise + Other CRQ (Fatigue)							
Behnke 2000a	15	1.6 (0.8)	15	-0.2 (1.5)		4.34%	1.83[1,2.66]
Cambach 1997	15	1.3 (1)	8	0 (1)		4.2%	1.25[0.39,2.11]
Casey 2013	176	0.5 (1.3)	170	0.3 (1.5)		8.34%	0.18[-0.11,0.47]
Faulkner 2010	6	-0.5 (3.8)	8	-0.4 (5)		0.25%	-0.1[-4.71,4.51]
Goldstein 1994	40	0.1 (1.2)	40	-0.3 (1.4)		6.2%	0.38[-0.18,0.94]
Gomez 2006	36	0.3 (0.7)	14	0.4 (0.7)		7.44%	-0.11[-0.52,0.3]
Griffiths 2000	93	1 (1.4)	91	-0.1 (1.1)		7.8%	1.11[0.75,1.47]
Lindsay 2005	21	0.4 (1.3)	20	0.4 (1.3)		4.48%	0.01[-0.8,0.82]
Wijkstra 1994	28	0.9 (1.3)	15	0.3 (1.1)		4.98%	0.63[-0.1,1.36]
Subtotal ***	**430**		**381**			**48.04%**	**0.61[0.18,1.03]**
Heterogeneity: Tau^2=0.29; Chi^2=38.42, df=8(P<0.0001); I^2=79.18%							
Test for overall effect: Z=2.78(P=0.01)							
Total ***	**697**		**594**			**100%**	**0.68[0.45,0.92]**
Heterogeneity: Tau^2=0.15; Chi^2=50.32, df=18(P<0.0001); I^2=64.23%							
Test for overall effect: Z=5.71(P<0.0001)							
Test for subgroup differences: Chi^2=0.26, df=1 (P=0.61), I^2=0%							

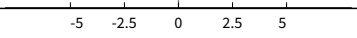


Favours usual care

Favours pulmonary rehab

Analysis 3.2. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 2 QoL - Change in CRQ (Emotional Function).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
3.2.1 QoL - Exercise Only CRQ (Emotional Function)							
Cebollero 2012	28	0.7 (0.7)	8	0.1 (0.6)		7.09%	0.55[0.07,1.03]
Gosselink 2000	34	0.5 (1.2)	28	-0.1 (1.3)		5.58%	0.62[-0.03,1.27]
Güell 1995	29	0.9 (1.4)	27	-0.1 (1.4)		4.9%	1[0.27,1.73]
Güell 1998	18	0.2 (1.1)	17	-0.5 (1.3)		4.44%	0.7[-0.1,1.5]
Hernandez 2000	20	0.8 (1.2)	17	0.3 (1.3)		4.33%	0.52[-0.3,1.34]
McNamara 2013	30	1.8 (4.5)	15	0.7 (4)		0.69%	1.1[-1.48,3.68]
O'Shea 2007	27	0.4 (0.8)	27	0.2 (0.7)		7.9%	0.2[-0.2,0.6]
Simpson 1992	14	0.4 (1.1)	14	0.1 (1.1)		4.44%	0.26[-0.54,1.06]
Singh 2003	20	0.9 (1.1)	20	0.2 (0.9)		5.77%	0.7[0.08,1.32]
Sridhar 2008	47	0.2 (1.4)	40	-0.4 (1.3)		6.2%	0.52[-0.05,1.09]
Subtotal ***	**267**		**213**			**51.36%**	**0.51[0.31,0.71]**
Heterogeneity: Tau^2=0; Chi^2=5.3, df=9(P=0.81); I^2=0%							
Test for overall effect: Z=5(P<0.0001)							
3.2.2 QoL - Exercise + Other CRQ (Emotional Function)							
Behnke 2000a	15	1.5 (0.9)	15	-0.2 (1.4)		4.14%	1.68[0.83,2.53]
Cambach 1997	15	0.7 (1.1)	8	0.3 (1)		3.84%	0.42[-0.48,1.32]
Casey 2013	176	0.2 (1.2)	170	0.2 (1.3)		9.28%	0[-0.26,0.26]
Faulkner 2010	6	-0.2 (3.7)	8	-2.6 (6.8)		0.15%	2.4[-3.16,7.96]
Goldstein 1994	40	0.2 (1.2)	40	-0.2 (1.3)		6.52%	0.44[-0.1,0.98]
Gomez 2006	36	0.8 (0.8)	14	0.5 (0.8)		6.81%	0.31[-0.2,0.82]
Griffiths 2000	93	1 (1.1)	91	-0.2 (1.2)		8.6%	1.16[0.83,1.49]
Lindsay 2005	21	0.4 (1.9)	20	0.3 (1.4)		3.31%	0.1[-0.91,1.11]
Wijkstra 1994	28	0.6 (1)	15	0 (0.9)		6%	0.53[-0.07,1.13]
Subtotal ***	**430**		**381**			**48.64%**	**0.58[0.16,1]**
Heterogeneity: Tau^2=0.28; Chi^2=38, df=8(P<0.0001); I^2=78.95%							
Test for overall effect: Z=2.68(P=0.01)							
Total ***	**697**		**594**			**100%**	**0.56[0.34,0.78]**
Heterogeneity: Tau^2=0.12; Chi^2=43.36, df=18(P=0); I^2=58.49%							
Test for overall effect: Z=4.96(P<0.0001)							
Test for subgroup differences: Chi^2=0.09, df=1 (P=0.77), I^2=0%							



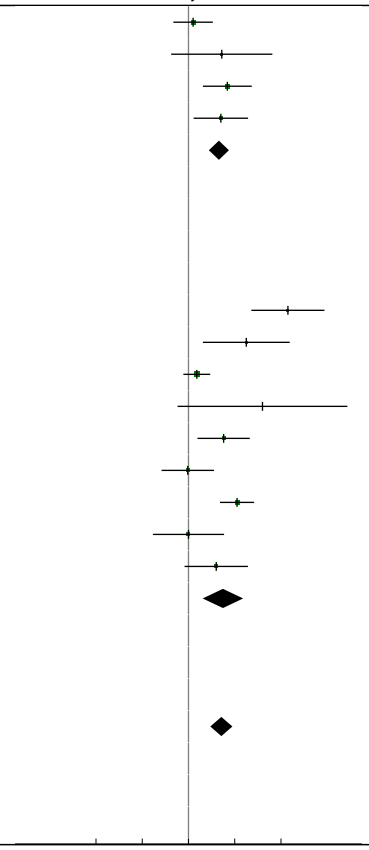
Favours usual care — Favours pulmonary rehab

Analysis 3.3. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 3 QoL - Change in CRQ (Mastery).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
3.3.1 QoL - Exercise Only CRQ (Mastery)							
Cebollero 2012	28	0.6 (0.8)	8	-0.1 (0.5)		7.19%	0.7[0.26,1.14]
Gosselink 2000	34	0.7 (1.4)	28	-0.2 (1.6)		4.94%	0.91[0.16,1.66]
Güell 1995	29	1 (1.2)	27	-0.2 (1.5)		5.16%	1.2[0.49,1.91]
Güell 1998	18	0.6 (1.1)	17	0 (1.1)		5.06%	0.6[-0.13,1.33]
Hernandez 2000	20	0.6 (1.3)	17	-0 (1.6)		3.82%	0.68[-0.27,1.63]
McNamara 2013	30	1.5 (2.9)	15	0.3 (2.3)		1.92%	1.15[-0.39,2.69]

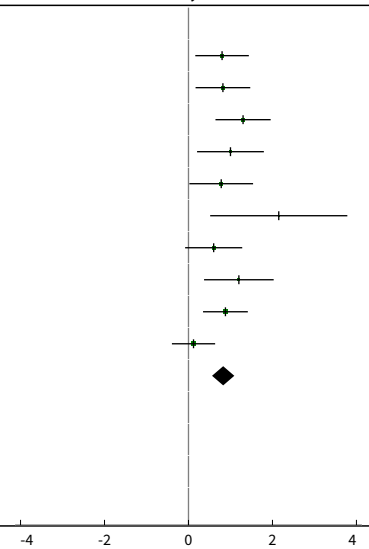
Favours usual care — Favours pulmonary rehab

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
O'Shea 2007	27	0.3 (0.8)	27	0.2 (0.8)		7.33%	0.1[-0.33,0.53]
Simpson 1992	14	0.9 (1.7)	14	0.1 (1.3)		3.19%	0.72[-0.37,1.81]
Singh 2003	20	0.9 (0.9)	20	0.1 (0.8)		6.53%	0.84[0.31,1.37]
Sridhar 2008	47	0.4 (1.3)	40	-0.3 (1.5)		6.06%	0.7[0.11,1.29]
Subtotal ***	**267**		**213**			**51.2%**	**0.66[0.44,0.88]**
Heterogeneity: Tau^2=0.01; Chi^2=10.13, df=9(P=0.34); I^2=11.14%							
Test for overall effect: Z=5.93(P<0.0001)							
3.3.2 QoL - Exercise + Other CRQ (Mastery)							
Behnke 2000a	15	2.1 (0.6)	15	-0.1 (1.5)		4.68%	2.15[1.36,2.94]
Cambach 1997	15	1 (1.3)	8	-0.2 (1)		3.87%	1.25[0.31,2.19]
Casey 2013	135	0.5 (1.1)	132	0.3 (1.3)		8.39%	0.18[-0.11,0.47]
Faulkner 2010	6	1.2 (1.6)	8	-0.4 (1.9)		1.44%	1.6[-0.24,3.44]
Goldstein 1994	40	0.7 (1.1)	40	-0.1 (1.4)		6.24%	0.76[0.2,1.32]
Gomez 2006	36	-0.6 (1)	14	-0.6 (0.9)		6.23%	-0.02[-0.58,0.55]
Griffiths 2000	93	1 (1.3)	91	-0.1 (1.3)		7.8%	1.05[0.68,1.42]
Lindsay 2005	21	0.3 (1.2)	20	0.3 (1.3)		4.81%	0[-0.77,0.77]
Wijkstra 1994	28	0.6 (1.2)	15	0 (1)		5.36%	0.6[-0.09,1.29]
Subtotal ***	**389**		**343**			**48.8%**	**0.74[0.31,1.18]**
Heterogeneity: Tau^2=0.31; Chi^2=38.67, df=8(P<0.0001); I^2=79.31%							
Test for overall effect: Z=3.33(P=0)							
Total ***	**656**		**556**			**100%**	**0.71[0.47,0.95]**
Heterogeneity: Tau^2=0.16; Chi^2=49, df=18(P=0); I^2=63.26%							
Test for overall effect: Z=5.82(P<0.0001)							
Test for subgroup differences: Chi^2=0.12, df=1 (P=0.73), I^2=0%							



Analysis 3.4. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 4 QoL - Change in CRQ (Dyspnoea).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
3.4.1 QoL - Exercise Only CRQ (Dyspnoea)							
Cebollero 2012	28	0.9 (0.9)	8	0.1 (0.8)		5.54%	0.8[0.16,1.44]
Gosselink 2000	34	0.8 (1.3)	28	-0 (1.3)		5.44%	0.82[0.17,1.47]
Güell 1995	29	1.2 (1.4)	27	-0.1 (1.1)		5.4%	1.3[0.64,1.96]
Güell 1998	18	0.8 (1.2)	17	-0.2 (1.2)		4.52%	1[0.2,1.8]
Hernandez 2000	20	1.1 (1.1)	17	0.3 (1.2)		4.74%	0.78[0.02,1.54]
McNamara 2013	30	2.2 (3.8)	15	0 (1.8)		1.7%	2.15[0.52,3.78]
O'Shea 2007	27	0.6 (1.5)	27	0 (1)		5.25%	0.6[-0.08,1.28]
Simpson 1992	12	1.2 (1.1)	10	0 (0.8)		4.33%	1.2[0.37,2.03]
Singh 2003	20	1 (0.9)	20	0.1 (0.8)		6.31%	0.88[0.35,1.41]
Sridhar 2008	47	-0.7 (1.2)	40	-0.8 (1.2)		6.46%	0.12[-0.39,0.63]
Subtotal ***	**265**		**209**			**49.69%**	**0.83[0.56,1.09]**
Heterogeneity: Tau^2=0.06; Chi^2=13.11, df=9(P=0.16); I^2=31.36%							
Test for overall effect: Z=6.1(P<0.0001)							
3.4.2 QoL - Exercise + Other CRQ (Dyspnoea)							

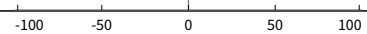


Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Behnke 2000a	15	2.4 (1.2)	15	0.2 (1.3)		3.86%	2.26[1.34,3.18]
Cambach 1997	14	1.2 (1.2)	8	0 (0.8)		4.27%	1.2[0.36,2.04]
Casey 2013	176	0.7 (1.4)	170	0.4 (1.5)		8.14%	0.28[-0.02,0.58]
Faulkner 2010	6	-0.8 (1)	8	-0.6 (0.7)		3.77%	-0.2[-1.14,0.74]
Goldstein 1994	40	0.7 (1.1)	39	0 (1.3)		6.26%	0.66[0.12,1.2]
Gomez 2006	36	0 (0.8)	14	-0.5 (0.7)		6.94%	0.52[0.07,0.97]
Griffiths 2000	93	1 (1.3)	91	-0.2 (1)		7.88%	1.18[0.85,1.51]
Lindsay 2005	21	1.2 (1.3)	20	1.1 (1.3)		4.5%	0.06[-0.74,0.86]
Wijkstra 1994	28	0.9 (1)	15	-0 (1.3)		4.68%	0.9[0.13,1.67]
Subtotal ***	**429**		**380**			**50.31%**	**0.74[0.35,1.13]**
Heterogeneity: Tau^2=0.25; Chi^2=35.12, df=8(P<0.0001); I^2=77.22%							
Test for overall effect: Z=3.73(P=0)							
Total ***	**694**		**589**			**100%**	**0.79[0.56,1.03]**
Heterogeneity: Tau^2=0.15; Chi^2=48.85, df=18(P=0); I^2=63.15%							
Test for overall effect: Z=6.61(P<0.0001)							
Test for subgroup differences: Chi^2=0.13, df=1 (P=0.72), I^2=0%							

Favours usual care — Favours pulmonary rehab

Analysis 3.5. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 5 QoL - Change in SGRQ (Total).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
3.5.1 QoL Exercise Only SGRQ (Total)							
Chan 2011	69	3.4 (16.1)	67	4 (14.8)		7.24%	-0.6[-5.8,4.6]
Chlumsky 2001	13	-4.1 (19.8)	6	-4.2 (19.2)		1.4%	0.15[-18.6,18.9]
De Souto Araujo 2012	21	-11.5 (14.5)	11	6.5 (8.8)		4.84%	-17.94[-26.04,-9.85]
Gohl 2006	10	-7.3 (25)	9	2 (24)		1.05%	-9.3[-31.34,12.74]
Paz-Diaz 2007	10	-7 (12)	14	3 (16)		3.19%	-10[-21.21,1.21]
Subtotal ***	**123**		**107**			**17.72%**	**-7.87[-16.72,0.98]**
Heterogeneity: Tau^2=62.83; Chi^2=13.51, df=4(P=0.01); I^2=70.39%							
Test for overall effect: Z=1.74(P=0.08)							
3.5.2 QoL Exercise + Other SGRQ (Total)							
Baumann 2012	37	-7 (10.5)	44	-1 (8.2)		8.28%	-6[-10.16,-1.84]
Boxall 2005	23	-5.8 (11.8)	23	-1.4 (13.3)		5.43%	-4.4[-11.67,2.87]
Deering 2011	11	-6.2 (8.6)	13	3.9 (9.4)		5.46%	-10.03[-17.27,-2.79]
Elci 2008	39	-14.4 (11.6)	39	3.8 (17.4)		6%	-18.2[-24.76,-11.64]
Engström 1999	26	0.3 (17.3)	24	0.5 (16.2)		4.11%	-0.2[-9.49,9.09]
Fernandez 2009	27	-14.7 (13.8)	14	-2.5 (12.7)		4.61%	-12.2[-20.65,-3.75]
Finnerty 2001	24	-9.3 (12.2)	25	-2.2 (15)		5.16%	-7.1[-14.74,0.54]
Gottlieb 2011	17	-5.2 (14.2)	18	0.4 (11.3)		4.55%	-5.62[-14.15,2.91]
Griffiths 2000	93	-7.1 (15.5)	91	1.3 (11.7)		8.48%	-8.4[-12.36,-4.44]
Gurgun 2013	30	-6.4 (8.1)	16	-0.2 (0.7)		9.52%	-6.27[-9.18,-3.36]
Karapolat 2007	26	-16.8 (15.2)	19	-3.7 (17.3)		3.87%	-13.1[-22.83,-3.37]
Ringbaek 2000	17	-2.1 (19)	19	-2.2 (17)		2.95%	0.1[-11.73,11.93]
Theander 2009	12	7.6 (10.8)	14	2.6 (12.2)		4.36%	5[-3.84,13.84]
Van Wetering 2010	87	-3.9 (10.3)	88	0.3 (9.4)		9.51%	-4.2[-7.11,-1.29]



Favours pulmonary rehab — Favours usual care

Study or subgroup	Pulmonary rehab N	Mean(SD)	Usual care N	Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Subtotal ***	**469**		**447**			**82.28%**	**-6.76[-9.19,-4.34]**
Heterogeneity: Tau²=10.17; Chi²=29.85, df=13(P=0); I²=56.45%							
Test for overall effect: Z=5.47(P<0.0001)							
Total ***	**592**		**554**			**100%**	**-6.89[-9.26,-4.52]**
Heterogeneity: Tau²=13.16; Chi²=43.39, df=18(P=0); I²=58.52%							
Test for overall effect: Z=5.7(P<0.0001)							
Test for subgroup differences: Chi²=0.06, df=1 (P=0.81), I²=0%							

Favours pulmonary rehab -100 -50 0 50 100 Favours usual care

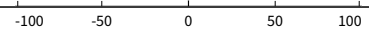
Analysis 3.6. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 6 QoL - Change in SGRQ (Symptoms).

Study or subgroup	Pulmonary rehab N	Mean(SD)	Usual care N	Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
3.6.1 QoL - Exercise Only SGRQ (Symptoms)							
Chan 2011	69	-1.2 (18.2)	67	4.5 (20.1)		9.46%	-5.7[-12.15,0.75]
Chlumsky 2001	13	-3.1 (23.2)	6	-4 (33.4)		0.75%	0.82[-28.73,30.37]
De Souto Araujo 2012	21	-7.8 (21.9)	11	3.9 (8.5)		4.75%	-11.71[-22.32,-1.1]
Gohl 2006	10	-2 (30)	9	2 (38)		0.68%	-4[-35.02,27.02]
Paz-Diaz 2007	10	-11 (13)	14	-1 (20)		3.31%	-10[-23.22,3.22]
Subtotal ***	**123**		**107**			**18.94%**	**-7.38[-12.33,-2.44]**
Heterogeneity: Tau²=0; Chi²=1.39, df=4(P=0.85); I²=0%							
Test for overall effect: Z=2.92(P=0)							
3.6.2 QoL - Exercise + Other SGRQ (Symptoms)							
Baumann 2012	37	-2 (18)	44	-5 (19.7)		6.94%	3[-5.22,11.22]
Boxall 2005	23	2 (18.9)	23	-0.6 (19.3)		4.46%	2.6[-8.44,13.64]
Deering 2011	11	-2.6 (15.6)	14	-1.9 (16.8)		3.51%	-0.78[-13.54,11.98]
Elci 2008	39	-5.2 (16.5)	39	0.8 (16.6)		8.06%	-5.98[-13.33,1.37]
Engström 1999	26	-7.5 (23.5)	24	-4.1 (23)		3.45%	-3.4[-16.29,9.49]
Fernandez 2009	27	-22.8 (20.4)	14	-9.1 (17.3)		3.95%	-13.7[-25.59,-1.81]
Finnerty 2001	24	-18.6 (13.7)	25	-3.8 (21.5)		5.16%	-14.8[-24.85,-4.75]
Gottlieb 2011	21	-3.1 (20.7)	20	-3.6 (18.6)		3.87%	0.49[-11.54,12.52]
Griffiths 2000	93	-5.5 (22.3)	91	-0.9 (18.8)		10.35%	-4.6[-10.55,1.35]
Gurgun 2013	30	-10.4 (14.8)	16	0.5 (1.1)		11.62%	-10.91[-16.23,-5.59]
Karapolat 2007	26	-22.3 (16.3)	19	-14.2 (24.7)		3.51%	-8.1[-20.85,4.65]
Ringbaek 2000	17	0.7 (22.2)	19	1.1 (24.7)		2.56%	-0.4[-15.72,14.92]
Theander 2009	12	10.6 (22.3)	14	-0.5 (29.3)		1.59%	11.1[-8.77,30.97]
Van Wetering 2010	87	-3 (17.7)	88	-1.4 (16.9)		12.03%	-1.6[-6.73,3.53]
Subtotal ***	**473**		**450**			**81.06%**	**-4.38[-7.62,-1.15]**
Heterogeneity: Tau²=13.88; Chi²=22.01, df=13(P=0.06); I²=40.93%							
Test for overall effect: Z=2.65(P=0.01)							
Total ***	**596**		**557**			**100%**	**-5.09[-7.69,-2.49]**
Heterogeneity: Tau²=7.79; Chi²=24.31, df=18(P=0.15); I²=25.95%							
Test for overall effect: Z=3.84(P=0)							
Test for subgroup differences: Chi²=0.99, df=1 (P=0.32), I²=0%							

Favours pulmonary rehab -100 -50 0 50 100 Favours usual care

Analysis 3.7. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 7 QoL - Change in SGRQ (Impacts).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
3.7.1 QoL - Exercise Only SGRQ (Impacts)							
Chan 2011	69	3.1 (17.8)	67	4.8 (16.7)		7.01%	-1.7[-7.5,4.1]
Chlumsky 2001	13	-4.8 (17.4)	6	-3.8 (4.4)		4.21%	-1.02[-11.12,9.08]
De Souto Araujo 2012	21	-9.8 (13.9)	11	8.2 (10.3)		5.08%	-17.93[-26.46,-9.41]
Gohl 2006	10	-4 (14)	9	0 (8)		4.19%	-4[-14.13,6.13]
Paz-Diaz 2007	10	-10 (14)	14	-4 (14)		3.63%	-6[-17.36,5.36]
Subtotal ***	**123**		**107**			**24.13%**	**-6.11[-12.6,0.38]**
Heterogeneity: Tau²=33.34; Chi²=10.67, df=4(P=0.03); I²=62.52%							
Test for overall effect: Z=1.84(P=0.07)							
3.7.2 QoL - Exercise + Other SGRQ (Impacts)							
Baumann 2012	37	-9 (15)	44	-1 (9.9)		7.13%	-8[-13.65,-2.35]
Boxall 2005	23	-8.1 (17.1)	23	-2 (17.6)		4.24%	-6.1[-16.13,3.93]
Deering 2011	11	-6.4 (14.1)	13	10.7 (16.6)		3.28%	-17.14[-29.41,-4.87]
Elci 2008	39	-15.3 (12.9)	39	2.8 (19.9)		5.78%	-18.08[-25.52,-10.64]
Engström 1999	26	2.6 (19.4)	24	2.5 (20.1)		3.8%	0.1[-10.87,11.07]
Fernandez 2009	27	-14.3 (16.3)	14	-1.8 (16.9)		3.89%	-12.5[-23.28,-1.72]
Finnerty 2001	24	-7.6 (15.7)	25	-1.5 (18)		4.55%	-6.1[-15.55,3.35]
Gottlieb 2011	18	-4.8 (12.8)	20	-0.1 (8.7)		6.07%	-4.69[-11.73,2.35]
Griffiths 2000	93	-8.2 (17.8)	91	2.4 (15.2)		7.84%	-10.6[-15.38,-5.82]
Gurgun 2013	30	-4.7 (10.4)	16	0.1 (1.5)		8.62%	-4.78[-8.59,-0.98]
Karapolat 2007	26	-18.4 (15.1)	19	0 (16.8)		4.5%	-18.4[-27.93,-8.87]
Ringbaek 2000	17	-4 (19.6)	19	-1.9 (18.2)		3.23%	-2.1[-14.5,10.3]
Theander 2009	12	9.7 (15.5)	14	3.4 (10.7)		4.06%	6.3[-4.11,16.71]
Van Wetering 2010	87	-4.1 (11.2)	88	0.5 (12.2)		8.89%	-4.6[-8.07,-1.13]
Subtotal ***	**470**		**449**			**75.87%**	**-7.61[-10.64,-4.57]**
Heterogeneity: Tau²=17.12; Chi²=32.04, df=13(P=0); I²=59.42%							
Test for overall effect: Z=4.91(P<0.0001)							
Total ***	**593**		**556**			**100%**	**-7.23[-9.91,-4.55]**
Heterogeneity: Tau²=17.94; Chi²=43.18, df=18(P=0); I²=58.31%							
Test for overall effect: Z=5.29(P<0.0001)							
Test for subgroup differences: Chi²=0.17, df=1 (P=0.68), I²=0%							

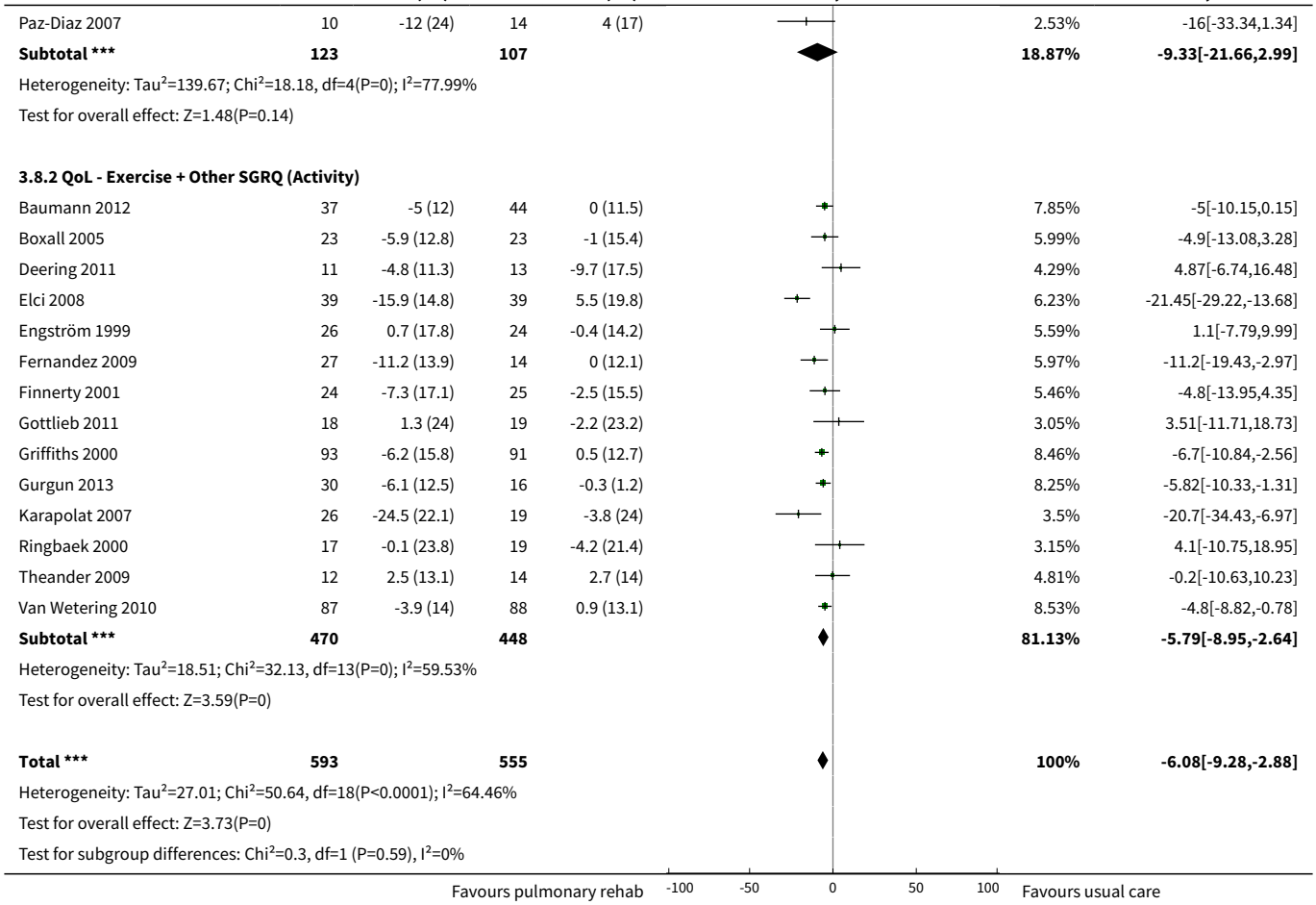


Favours pulmonary rehab — Favours usual care

Analysis 3.8. Comparison 3 Rehabilitation versus usual care (subgroup analysis exercise only vs exercise and other), Outcome 8 QoL - Change in SGRQ (Activity).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
3.8.1 QoL - Exercise Only SGRQ (Activity)							
Chan 2011	69	6.4 (20.1)	67	2.4 (18.2)		7.04%	4[-2.44,10.44]
Chlumsky 2001	13	-8.6 (26.1)	6	-3.9 (1.8)		3.33%	-4.79[-19.07,9.49]
De Souto Araujo 2012	21	-16.5 (20.1)	11	4.2 (9.9)		4.82%	-20.75[-31.17,-10.34]
Gohl 2006	10	-12 (44)	9	2 (10)		1.15%	-14[-42.04,14.04]

Favours pulmonary rehab — Favours usual care



Comparison 4. Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 QoL - Change in CRQ (Dyspnoea)	5	384	Mean Difference (IV, Random, 95% CI)	0.99 [0.64, 1.34]
1.1 QoL - Low Risk CRQ (Dyspnoea)	5	384	Mean Difference (IV, Random, 95% CI)	0.99 [0.64, 1.34]
2 QoL - Change in CRQ (Emotional Function)	5	386	Mean Difference (IV, Random, 95% CI)	0.60 [0.09, 1.11]
2.1 QoL - Low Risk (Emotional Function)	5	386	Mean Difference (IV, Random, 95% CI)	0.60 [0.09, 1.11]
3 QoL - Low Risk CRQ (Fatigue)	5	386	Mean Difference (IV, Random, 95% CI)	0.90 [0.41, 1.39]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
4 QoL - Low Risk CRQ (Mastery)	5	386	Mean Difference (IV, Random, 95% CI)	0.77 [0.28, 1.26]
5 QoL - Low Risk SGRQ (Total)	7	572	Mean Difference (IV, Random, 95% CI)	-5.15 [-7.95, -2.36]
6 QoL - Low Risk SGRQ (Symptoms)	7	572	Mean Difference (IV, Random, 95% CI)	-4.12 [-8.45, 0.21]
7 QoL - Low Risk SGRQ (Impacts)	7	572	Mean Difference (IV, Random, 95% CI)	-5.92 [-10.01, -1.82]
8 QoL - Low Risk SGRQ (Activity)	7	572	Mean Difference (IV, Random, 95% CI)	-5.33 [-8.10, -2.57]

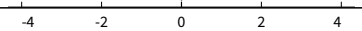
Analysis 4.1. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 1 QoL - Change in CRQ (Dyspnoea).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
4.1.1 QoL - Low Risk CRQ (Dyspnoea)							
Cambach 1997	14	1.2 (1.2)	8	0 (0.8)		13.49%	1.2[0.36,2.04]
Goldstein 1994	40	0.7 (1.1)	39	0 (1.3)		24.74%	0.66[0.12,1.2]
Griffiths 2000	93	1 (1.3)	91	-0.2 (1)		39.15%	1.18[0.85,1.51]
McNamara 2013	30	2.2 (3.8)	15	0 (1.8)		4.25%	2.15[0.52,3.78]
O'Shea 2007	27	0.6 (1.5)	27	0 (1)		18.37%	0.6[-0.08,1.28]
Subtotal ***	**204**		**180**			**100%**	**0.99[0.64,1.34]**
Heterogeneity: Tau^2=0.05; Chi^2=6.09, df=4(P=0.19); I^2=34.27%							
Test for overall effect: Z=5.55(P<0.0001)							
Total ***	**204**		**180**			**100%**	**0.99[0.64,1.34]**
Heterogeneity: Tau^2=0.05; Chi^2=6.09, df=4(P=0.19); I^2=34.27%							
Test for overall effect: Z=5.55(P<0.0001)							

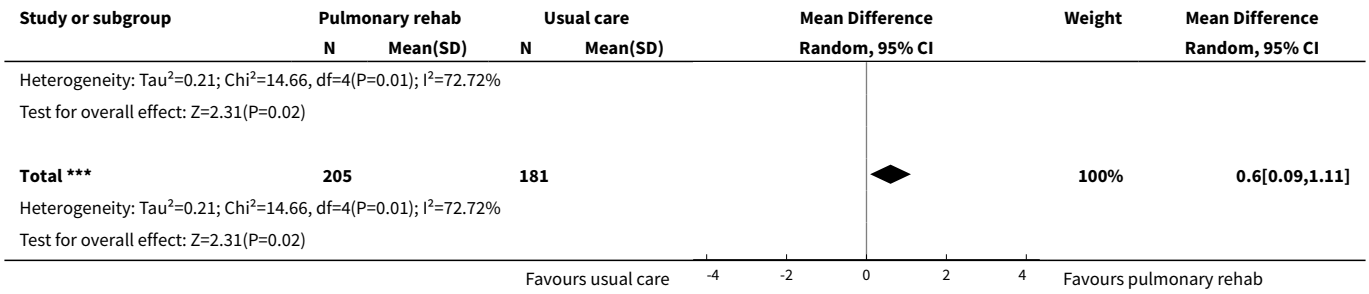
Favours usual care — Favours pulmonary rehab

Analysis 4.2. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 2 QoL - Change in CRQ (Emotional Function).

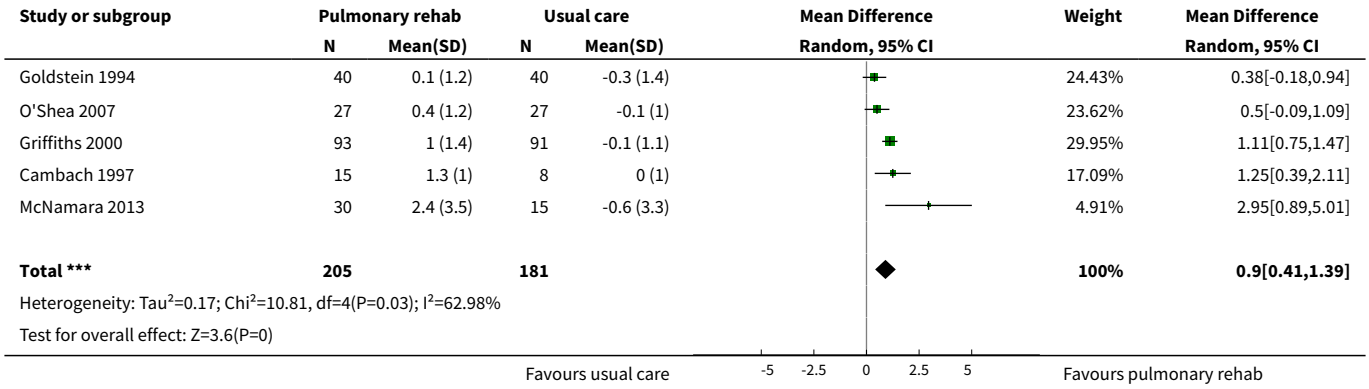
Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
4.2.1 QoL - Low Risk (Emotional Function)							
Cambach 1997	15	0.7 (1.1)	8	0.3 (1)		16.25%	0.42[-0.48,1.32]
Goldstein 1994	40	0.2 (1.2)	40	-0.2 (1.3)		24.05%	0.44[-0.1,0.98]
Griffiths 2000	93	1 (1.1)	91	-0.2 (1.2)		28.84%	1.16[0.83,1.49]
McNamara 2013	30	1.8 (4.5)	15	0.7 (4)		3.52%	1.1[-1.48,3.68]
O'Shea 2007	27	0.4 (0.8)	27	0.2 (0.7)		27.34%	0.2[-0.2,0.6]
Subtotal ***	**205**		**181**			**100%**	**0.6[0.09,1.11]**



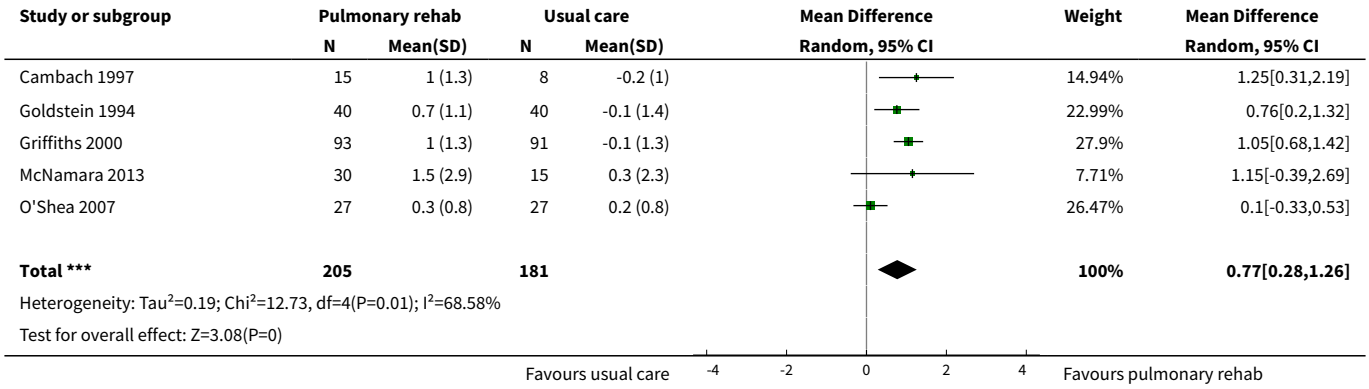
Favours usual care — Favours pulmonary rehab



Analysis 4.3. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 3 QoL - Low Risk CRQ (Fatigue).



Analysis 4.4. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 4 QoL - Low Risk CRQ (Mastery).

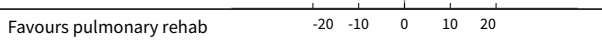


Analysis 4.5. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 5 QoL - Low Risk SGRQ (Total).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Boxall 2005	23	-5.8 (11.8)	23	-1.4 (13.3)		10.21%	-4.4[-11.67,2.87]
Engström 1999	26	0.3 (17.3)	24	0.5 (16.2)		7.11%	-0.2[-9.49,9.09]
Griffiths 2000	93	-7.1 (15.5)	91	1.3 (11.7)		19.83%	-8.4[-12.36,-4.44]
Gurgun 2013	30	-6.4 (8.1)	16	-0.2 (0.7)		24.31%	-6.27[-9.18,-3.36]
Karapolat 2007	26	-16.8 (15.2)	19	-3.7 (17.3)		6.6%	-13.1[-22.83,-3.37]
Theander 2009	12	7.6 (10.8)	14	2.6 (12.2)		7.67%	5[-3.84,13.84]
Van Wetering 2010	87	-3.9 (10.3)	88	0.3 (9.4)		24.27%	-4.2[-7.11,-1.29]
Total ***	**297**		**275**			**100%**	**-5.15[-7.95,-2.36]**

Heterogeneity: Tau²=6.17; Chi²=12.19, df=6(P=0.06); I²=50.78%

Test for overall effect: Z=3.61(P=0)



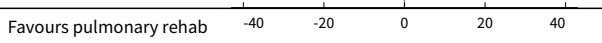
Favours pulmonary rehab — Favours usual care

Analysis 4.6. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 6 QoL - Low Risk SGRQ (Symptoms).

Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Boxall 2005	23	2 (18.9)	23	-0.6 (19.3)		10.72%	2.6[-8.44,13.64]
Engström 1999	26	-7.5 (23.5)	24	-4.1 (23)		8.55%	-3.4[-16.29,9.49]
Griffiths 2000	93	-5.5 (22.3)	91	-0.9 (18.8)		21.18%	-4.6[-10.55,1.35]
Gurgun 2013	30	-10.4 (14.8)	16	0.5 (1.1)		23.04%	-10.91[-16.23,-5.59]
Karapolat 2007	26	-22.3 (16.3)	19	-14.2 (24.7)		8.7%	-8.1[-20.85,4.65]
Theander 2009	12	10.6 (22.3)	14	-0.5 (29.3)		4.19%	11.1[-8.77,30.97]
Van Wetering 2010	87	-3 (17.7)	88	-1.4 (16.9)		23.62%	-1.6[-6.73,3.53]
Total ***	**297**		**275**			**100%**	**-4.12[-8.45,0.21]**

Heterogeneity: Tau²=13.82; Chi²=11.05, df=6(P=0.09); I²=45.73%

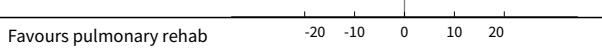
Test for overall effect: Z=1.86(P=0.06)



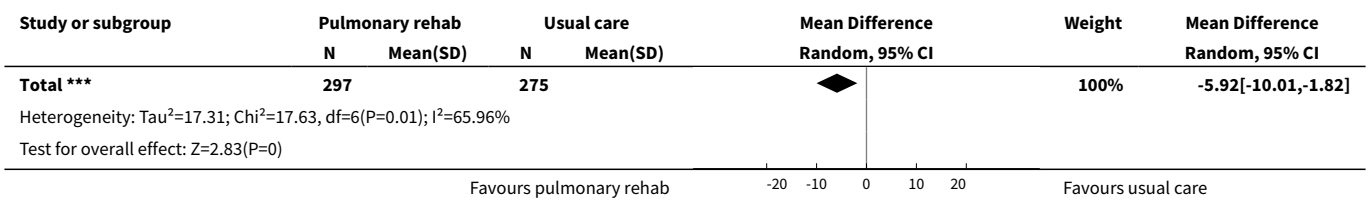
Favours pulmonary rehab — Favours usual care

Analysis 4.7. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 7 QoL - Low Risk SGRQ (Impacts).

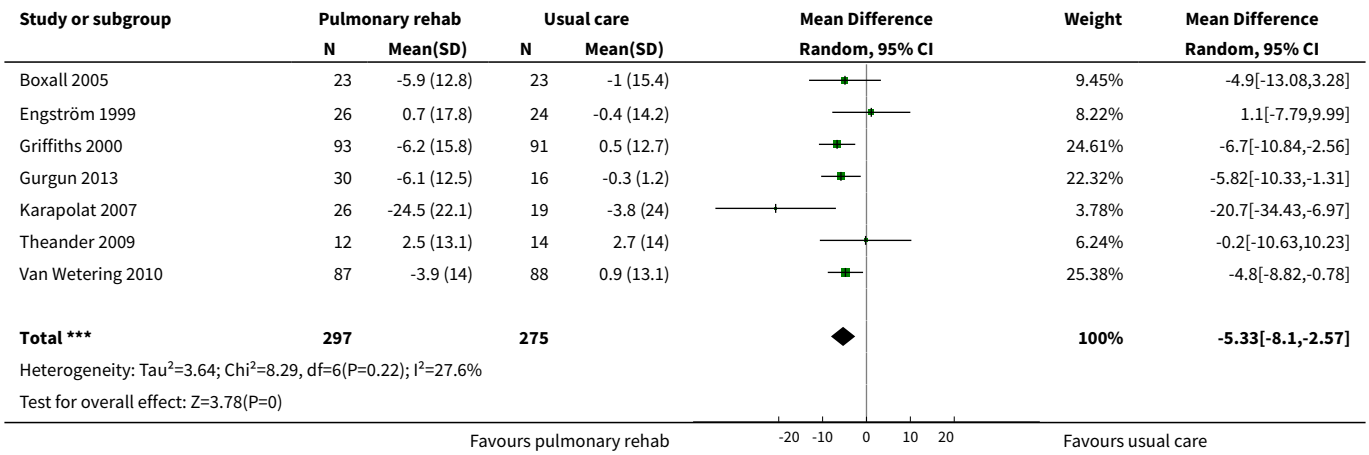
Study or subgroup	Pulmonary rehab N	Pulmonary rehab Mean(SD)	Usual care N	Usual care Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Boxall 2005	23	-8.1 (17.1)	23	-2 (17.6)		10.03%	-6.1[-16.13,3.93]
Engström 1999	26	2.6 (19.4)	24	2.5 (20.1)		8.97%	0.1[-10.87,11.07]
Griffiths 2000	93	-8.2 (17.8)	91	2.4 (15.2)		18.75%	-10.6[-15.38,-5.82]
Gurgun 2013	30	-4.7 (10.4)	16	0.1 (1.5)		20.68%	-4.78[-8.59,-0.98]
Karapolat 2007	26	-18.4 (15.1)	19	0 (16.8)		10.65%	-18.4[-27.93,-8.87]
Theander 2009	12	9.7 (15.5)	14	3.4 (10.7)		9.58%	6.3[-4.11,16.71]
Van Wetering 2010	87	-4.1 (11.2)	88	0.5 (12.2)		21.34%	-4.6[-8.07,-1.13]



Favours pulmonary rehab — Favours usual care



Analysis 4.8. Comparison 4 Rehabilitation versus usual care (sensitivity analysis by allocation concealment and incomplete outcome), Outcome 8 QoL - Low Risk SGRQ (Activity).



ADDITIONAL TABLES

Table 1. Publication bias: results of Egger and Begg-Mazumdar Kendall's tests

CRQ Fatigue	Bias indicators
	Begg-Mazumdar: Kendall's tau = 0.22807; P value 0.1863
	Egger: bias = 1.61189 (95% CI = -0.194745 to 3.418525); P value 0.077
CRQ Emotional	Bias indicators
	Begg-Mazumdar: Kendall's tau = 0.204678; P value 0.2378
	Egger: bias = 0.997332 (95% CI = -0.618039 to 2.612702); P value 0.2101
CRQ Mastery	Bias indicators
	Begg-Mazumdar: Kendall's tau = 0.146199; P value 0.4063
	Egger: bias = 1.531134 (95% CI = -0.268167 to 3.330434); P value 0.0904
CRQ Dyspnoea	Bias indicators
(see Figure 1 for funnel plot)	Begg-Mazumdar: Kendall's tau = 0.274854; P value 0.1082
	Egger: bias = 1.275427 (95% CI = -0.761574 to 3.312427); P value 0.204
SGRQ Total	Bias indicators

Table 1. Publication bias: results of Egger and Begg-Mazumdar Kendall's tests *(Continued)*

(see Figure 2 for funnel plot)	Begg-Mazumdar: Kendall's tau = -0.052632; P value 0.73 Egger: bias = -0.459813 (95% CI = -2.086751 to 1.167125); P value 0.5588
SGRQ Symptoms	Bias indicators Begg-Mazumdar: Kendall's tau = 0.017544; P value 0.945 Egger: bias = 0.076734 (95% CI = -1.241745 to 1.395213); P value 0.9037
SQRQ Activity	Bias indicators Begg-Mazumdar: Kendall's tau = -0.052632; P value 0.73 Egger: bias = -0.336937 (95% CI = -2.10096 to 1.427086); P value 0.692
6MWT	Bias indicators Begg-Mazumdar: Kendall's tau = 0.16074; P value 0.1601 Egger: bias = 1.24304 (95% CI = 0.183967 to 2.302131); P value 0.0227
Incremental Shuttle Walk Test	Bias indicators Begg-Mazumdar: Kendall's tau = 0.0776906; P value 0.846 Egger: bias = -0.21 2523 (95% CI = -2.7776 to 2.351859); P value 0.846
Cycle Ergometer	Bias indicators Begg-Mazumdar: Kendall's tau = -0.2666667; P value 0.139 Egger: bias = 1.57164 (95% CI = 0.6053 to 2.337984); P value 0.0036

Table 2. Baseline characteristics

Study	Rehab sample size	Male	Female	Mean age (SD)	FEV_1 (SD)	Control sample size	Male	Female	Mean age (SD)	FEV_1 (SD)
Barakat 2008	35	na	na	63.7	41.9	36	na	na	65.9	43.3
Baumann 2012	37	na	na	65	45	44	na	na	63	47
Behnke 2000a	23	12	3	64.0 (1)	34.1 (7.4)	23	11	4	68.0 (2.2)	37.5 (6.6)
Bendstrup 1997	27	7	9	64 (3)	1.02 L/min (0.06)	20	7	9	65 (2)	1.04 L/min (0.07)
Booker 1984	32	na	na	66 (8)	0.85 L (0.29)	37	na	na	65 (7)	0.97 L (0.37)
Borghi-Silva 2009	20	13	7	67 (10)	33 (9)	14	12	8	67(10)	35 (11)
Boxall 2005	23	11	12	77.6 (7.6)	40.5 (15.9)	23	15	8	75.8 (8.1)	37.7 (15.0)
Busch 1988	7	5	2	65 (16)	26% (9)	7	6	1	66 (16)	27% (11)
Cambach 1997	15	7	8	62 (5)	59% (16)	8	6	2	62 (9)	60% (23)
Casaburi 2004	12	12	0	69 (10)	36% (9)	12	12	0	68 (9)	39% (12)
Casey 2013	178	117	61	68.8 (10.2)	57.6 (14.3)	172	106	66	68.4 (10.3)	59.7 (13.8)
Cebollero 2012	28	28	0	68 (7)	47.8 (5)	8	8	0	69(5)	38.7 (5)
Chan 2011	69	61	8	73.6 (7.5)	91 (0.39)	67	58	9	73.6 (7.4)	89 (0.39)
Chlumsky 2001	13	12	1	63 (11)	43% (21)	6	5	1	65 (13)	51% (17)
Clark 1996	32	na	na	58 (8)	1.72 L (0.83)	16	na	na	55 (8)	1.44 L (0.59)
Cochrane 2006	74	32	42	na	na	50	18	32	na	na
Cockcroft 1981	18	18	0	61 (5)	1.53 L (0.70)	16	16	0	60 (5)	1.32 L (0.44)
De Souto Araujo 2012	21	12	9	59	39.2 (11.4) /43.9 (10.3)	11	8	3	71.1	45.1 (12.6)

Table 2. Baseline characteristics *(Continued)*

Deering 2011	25	11	14	67.7 (5.3)	77.0 (19)	19	8	8	68.6 (5.5)	45.8 (18.3)
Elci 2008	39	33	6	59.67 (8.6)	47.7	39	33	6	58.08 (11.45)	46.28
Emery 1998	25	15	14	65 (6)	1.29 L (0.63)	25	12	13	67 (7)	1.02 L (0.37)
Engström 1999	26	14	12	66 (5)	31% (11)	24	12	12	67 (5)	34% (10)
Faager 2004	10	3	7	72 (9)	26 (7)	10	3	7	70 (8)	28 (6)
Faulkner 2010	10	na	na	na	na	10	na	na	na	na
Fernandez 2009	30	29	1	66 (8)	33 (10)	20	20	0	70 (5)	38 (12)
Finnerty 2001	36	25	11	70 (8)	41% (19)	29	19	10	68 (10)	41% (16)
Gohl 2006	17	6	4	62.5 (7)	53.4 (10.7)	17	7	2	53.7 (5.8)	63.2 (8.5)
Goldstein 1994	38	21	17	66 (7)	35% (15)	40	17	23	65 (8)	35% (12)
Gosselink 2000	37	31	6	60 (9)	41% (16)	33	30	3	63 (7)	43% (12)
Gottlieb 2011	35	7	15	74.1 (66–82)	64.27 (7.9)	26	7	13	73.2 (67–88)	67.05 (8.8)
Griffiths 2000	93	57	37	68 (8)	40% (16)	91	54	37	68 (8)	39% (16)
Gurgun 2013	30	28	28	64.0 (10.8)	41.9 (10.8)	16	15	1	67.8 (6.6)	39.3 (9.3)
Güell 1995	30	30	30	64 (7)	31% (12)	30	30	0	66 (6)	39% (14)
Güell 1998	18	16	2	68 (8)	32% (11)	17	17	0	66 (8)	38% (15)
Hernandez 2000	20	20	0	64 (8)	71.1 (18.9)	17	17	0	63 (7)	74.7 (14.7)
Hoff 2007	6	4	2	62.8 (1.4)	49.9 (4.6)	6	4	2	60.6 (3.0)	45.2 (6.0)
Jones 1985	8	6	2	64 (6)	0.78 L (0.27)	6	1	5	63 (8)	0.68 L (0.12)
Karapolat 2007	26	21	5	64.81 (9.4)	55.50%	19	18	1	67.21 (6.72)	58%
Lake 1990	7	6	1	66.3 (6.8)	0.83 L (0.25)	7	4	3	65.7 (3.5)	0.97 L (0.29)

Table 2. Baseline characteristics *(Continued)*

Lindsay 2005	25	20	5	69.5 (9.3)	0.9 L (0.3)	25	18	7	69.8 (10.3)	0.8 L (0.4)
Liu 2012	36	26	10	61.34 (8.3)	61.27 (5.86)	36	29	7	62.2 (6.34)	61.43 (6.17)
McGavin 1977	12	12	0	61 (6)	0.97 L (0.33)	12	12	0	57 (8)	1.15 L (0.72)
McNamara 2013	38	18	15	72 (10)	60 (10)	15	8	7	70 (9)	55 (20)
Mehri 2007	20	11	9	52.1 (10.7)	na	18	7	11	52.17 (11.6)	na
Mendes De Oliveira 2010	56	46	10	66.4/71.3	47.5/ 51.5	29	19	10	70.8	41.4
Nalbant 2011	14	11	3	73.5	58.5 (48-65)	15	13	2	68	57 (44-66)
O'Shea 2007	27	na	na	66.9 (7)	49	27	na	na	68.4 (9.9)	52
Ozdemir 2010	25	25	0	60.9 (8.8)	54.5 (15.6)	25	25	0	64.1 (8.9)	54.1 (20.2)
Paz-Diaz 2007	10	6	4	67 (5)	34 (11)	14	12	2	62 (7)	30 (9)
Petty 2006	149	80	69	68.8 (9.2)	na	73	40	33	66.8 (9.9)	na
Reardon 1994	10	5	5	66 (8)	35% (10)	10	5	5	66 (7)	33% (15)
Ringbaek 2000	24	1	23	62 (7)	50% (17)	21	6	15	65 (8)	44% (14)
Gomez 2006	64	39	9	64.1/64.9	74 (66.5-81.5)	33	19	4	63.4	60.1 (55.6-64.4)
Simpson 1992	14	5	9	73 (5)	40% (19)	14	10	4	70 (6)	39% (21)
Singh 2003	20	na	na	na	28 (7.5)	20	na	na	na	26 (7.1)
Sridhar 2008	61	30	31	69.9 (9.6)	42.9 (15.5)	61	30	31	69.68 (10.4)	48.9 (18.69)
Strijbos 1996	15	14	1	61 (6)	40% (20)	15	12	3	63 (5)	43% (9)
Theander 2009	15	3	9	66	35.1 (7.6)	15	10	4	64	32.3 (9.5)
Vallet 1994	10	7	3	60 (9)	57.2	10	8	2	58 (6)	55.7

Table 2. Baseline characteristics *(Continued)*

Van Wetering 2010	102	72	30	65.9 (8.8)	58 (17)	97	69	28	67.2 (8.9)	60 (15)
Vijayan 2010	16	na	na	na	na	15	na	na	na	na
Weiner 1992	12	6	6	67 (9)	32.8 (3)	12	5	7	61 (9)	39.2 (2.8)
Wen 2008	32	31	1	67 (7)/68 (7)	46 (10)/50 (14)	9	9	0	66(10)	52 (14)
Wijkstra 1994	28	23	5	64 (5)	44% (11)	15	14	1	62 (5)	45% (9)
Xie 2003	25	22	3	54 (6)	42% (16)	25	21	4	54 (6)	40% (17)

na: not available.

Table 3. Study design

Study	Follow-up	Duration (weeks)	Setting	Programme type
Barakat 2008	14 weeks	14	Outpatient	Exercise + other
Baumann 2012	6 months	8	Community	Exercise + other
Behnke 2000a	3, 6 months	24	Inpatient	Exercise + other
Bendstrup 1997	12, 24 weeks	12	Outpatient	Exercise
Booker 1984	3, 6, 12 months	9	Home	Exercise + other
Borghi-Silva 2009	6 weeks	6	Outpatient	Exercise
Boxall 2005	12 weeks	12	Home	Exercise + other
Busch 1988	18 weeks	18	Home	Exercise
Cambach 1997	3 months	12	Community	Exercise + other
Casaburi 2004	10 weeks	10	Outpatient	Exercise + other
Casey 2013	12 weeks	8	Community	Exercise + other
Cebollero 2012	12 weeks	12	Outpatient	Exercise
Chan 2011	3 months	12	Community	Exercise
Chlumsky 2001	8 weeks	8	Outpatient	Exercise
Clark 1996	12 weeks	12	Home	Exercise
Cochrane 2006	6 weeks, 6 months, 12 months	6	Outpatient	Exercise + other
Cockcroft 1981	2, 6 months	6	Outpatient	Exercise
De Souto Araujo 2012	8 weeks	8	Community	Exercise
Deering 2011	8 weeks	7	Outpatient	Exercise + other
Elci 2008	1, 3 months	12	Community /Home	Exercise + other
Emery 1998	10 weeks	10	Outpatient	Exercise + other
Engström 1999	12 months	52	Outpatient /Home	Exercise + other
Faager 2004	8 weeks, 6 months	8	Inpatient /Home	Exercise + other

Table 3. Study design *(Continued)*

Faulkner 2010	week 9	8	Community	Exercise + other
Fernandez 2009	1 year	52	Home	Exercise + other
Finnerty 2001	12, 24 weeks	6	Outpatient	Exercise + other
Gohl 2006	12 months	52	Community	Exercise
Goldstein 1994	24 weeks	8	Inpatient	Exercise + other
Gosselink 2000	6, 18 months	24	Outpatient	Exercise
Gottlieb 2011	6 months	7	Community	Exercise + other
Griffiths 2000	1 year	6	Outpatients /Home	Exercise + other
Gomez 2006	3, 6 months	12	Community	Exercise + other
Güell 1995	3, 6, 9, 12, 18, 24 months	12	Outpatient /Home	Exercise
Güell 1998	8 weeks	8	Outpatient	Exercise
Gurgun 2013	8 weeks, 6 months	8	Outpatient	Exercise + other
Hernandez 2000	12 weeks	12	Home	Exercise
Hoff 2007	8 weeks	8	Outpatient	Exercise
Jones 1985	10 weeks	10	Home	Exercise
Karapolat 2007	8, 12 weeks	8	Outpatient	Exercise + other
Lake 1990	8 weeks	8	Outpatient	Exercise
Lindsay 2005	6 weeks, 3 months	6	Community	Exercise + other
Liu 2012	6 months	24	Inpatient /Home	Exercise
McGavin 1977	14 weeks	?12	Home	Exercise
McNamara 2013	8 weeks	8	Outpatient	Exercise
Mehri 2007	4 weeks	4	Outpatient	Exercise
Mendes De Oliveira 2010	12 weeks	12	Outpatient /Home	Exercise + other
Nalbant 2011	3, 6 months	24	Nursing home	Exercise + other
O'Shea 2007	3, 6 months	12	Outpatient	Exercise

Table 3. Study design *(Continued)*

			/Home	
Ozdemir 2010	1 month	4	Outpatient	Exercise
Paz-Diaz 2007	8 weeks	8	Outpatient	Exercise
Petty 2006	8 weeks	8	Home	Exercise + other
Reardon 1994	6 weeks	6	Outpatient	Exercise + other
Ringbaek 2000	8 weeks	8	Outpatient	Exercise + other
Simpson 1992	8 weeks	8	Outpatient	Exercise
Singh 2003	4 weeks	4	Home	Exercise
Sridhar 2008	6 months	6	Outpatients /Home	Exercise + other
Strijbos 1996	3, 6, 12, 18 months	12	Outpatient	Exercise + other
Theander 2009	12 weeks	12	Outpatient /Home	Exercise + other
Vallet 1994	8 weeks	8	Inpatient	Exercise
Van Wetering 2010	4 months	12	Community	Exercise + other
Vijayan 2010	Unclear	6	Unclear	Exercise
Weiner 1992	6 months	24	Outpatient	Exercise
Wen 2008	12 weeks	12	Outpatient	Exercise
Wijkstra 1994	12 weeks	12	Outpatient /Home	Exercise + other
Xie 2003	12 weeks	12	Home	Exercise

Table 4. Summary of subgroup analysis

Pulmonary rehabilitation versus usual care. Subgroup: community versus hospital-delivered programme

Outcome	Subscale	Subgroups	Heterogeneity	MD [95% CI]	Test for subgroup differences
CRQ	Fatigue	Community	$Tau^2 = 0.10$; $I^2 = 52\%$	0.44 [0.14, 0.75]	$Chi^2 = 3.98$, df = 1 (P value 0.05), $I^2 = 74.9\%$
		Hospital	$Tau^2 = 0.09$; $I^2 = 51\%$	0.86 [0.58, 1.14]	
CRQ	Emotional Function	Community	$Tau^2 = 0.00$; $I^2 = 0\%$	0.21 [0.04, 0.39]	$Chi^2 = 12.24$, df = 1 (P value 0.0005), $I^2 = 91.8\%$

Table 4. Summary of subgroup analysis *(Continued)*

		Hospital	Tau² = 0.06; I² = 39%	0.77 [0.51, 1.03]	
CRQ	Mastery	Community	Tau² = 0.07; I² = 45%	0.40 [0.12, 0.67]	Chi² = 8.58, df = 1 (P value 0.003), I² = 88.3%
		Hospital	Tau² = 0.05; I² = 31%	0.95 [0.70, 1.20]	
CRQ	Dyspnoea	Community	Tau² = 0.03; I² = 26%	0.58 [0.34, 0.81]	Chi² = 4.05, df = 1 (P value 0.04), I² = 75.3%
		Hospital	Tau² = 0.17; I² = 60%	0.99 [0.66, 1.32]	
SGRQ	Total	Community	Tau² = 24.00; I² = 73%	-8.15 [-12.16, -4.13]	Chi² = 0.69, df = 1 (P value 0.41), I² = 0%
		Hospital	Tau² = 6.41; I² = 35%	-6.05 [-8.91, -3.20]	
SGRQ	Symptoms	Community	Tau² = 6.28; I² = 24%	-3.66 [-7.07, -0.24]	Chi² = 1.65, df = 1 (P value 0.20), I² = 39.2%
		Hospital	Tau² = 4.96; I² = 15%	-6.91 [-10.51, -3.30]	
SGRQ	Impact	Community	Tau² = 19.91; I² = 63%	-8.17 [-12.00, -4.34]	Chi² = 0.46, df = 1 (P value 0.50), I² = 0%
		Hospital	Tau² = 22.39; I² = 58%	-6.21 [-10.33, -2.09]	
SGRQ	Activity	Community	Tau² = 48.91; I² = 78%	-7.82 [-13.37, -2.28]	Chi² = 0.93, df = 1 (P value 0.33), I² = 0%
		Hospital	Tau² = 10.45; I² = 36%	-4.58 [-8.16, -1.00]	
Pulmonary rehabilitation versus usual care. Subgroup: exercise only programme versus exercise plus additional elements in programme					
Outcome	**Subscale**	**Subgroups**	**Heterogeneity**	**MD [95% CI]**	**Test for subgroup differences**
CRQ	Fatigue	Exercise only	Tau² = 0.00; I² = 0%	0.73 [0.54, 0.92]	Chi² = 0.26, df = 1 (P value 0.61), I² = 0%
		Exercise + other	Tau² = 0.29; I² = 79%	0.61 [0.18, 1.03]	
CRQ	Emotional Function	Exercise only	Tau² = 0.00; I² = 0%	0.51 [0.31, 0.71]	Chi² = 0.09, df = 1 (P value 0.77), I² = 0%
		Exercise + other	Tau² = 0.28; I² = 79%	0.58 [0.16, 1.00]	
CRQ	Mastery	Exercise only	Tau² = 0.01; I² = 11%	0.66 [0.44, 0.88]	Chi² = 0.12, df = 1 (P value 0.73), I² = 0%
		Exercise + other	Tau² = 0.31; I² = 79%	0.74 [0.31, 1.18]	
CRQ	Dyspnoea	Exercise only	Tau² = 0.06; I² = 31%	0.83 [0.56, 1.10]	Chi² = 0.13, df = 1 (P value 0.72), I² = 0%
		Exercise + other	Tau² = 0.25; I² = 77%	0.74 [0.35, 1.13]	
SGRQ	Total	Exercise only	Tau² = 62.83; I² = 70%	-7.87 [-16.72, 0.98]	
		Exercise + other	Tau² = 10.17; I² = 56%	-6.76 [-9.19, -4.34]	Chi² = 0.06, df = 1 (P value 0.81), I² = 0%

Table 4. Summary of subgroup analysis *(Continued)*

SGRQ	Symptoms	Exercise only	$Tau^2 = 0.00$; $I^2 = 0\%$	-7.38 [-12.33, -2.44]	
		Exercise + other	$Tau^2 = 13.88$; $I^2 = 41\%$	-4.38 [-7.62, -1.15]	$Chi^2 = 0.99$, df = 1 (P value 0.32), $I^2 = 0\%$
SGRQ	Impact	Exercise only	$Tau^2 = 33.34$; $I^2 = 63\%$	-6.11 [-12.60, 0.38]	
		Exercise + other	$Tau^2 = 17.12$; $I^2 = 59\%$	-7.61 [-10.64, -4.57]	$Chi^2 = 0.17$, df = 1 (P value 0.68), $I^2 = 0\%$
SGRQ	Activity	Exercise only	$Tau^2 = 139.67$; $I^2 = 78\%$	-9.33 [-21.66, 2.99]	$Chi^2 = 0.30$, df = 1 (P value 0.59), $I^2 = 0\%$
		Exercise + other	$Tau^2 = 18.51$; $I^2 = 60\%$	-5.79 [-8.95, -2.64]	

CRQ: Chronic Respiratory Disease Questionnaire; MD: mean difference; SGRQ: St. George's Respiratory Questionnaire.

APPENDICES

Appendix 1. Archive of previous search methods and results

Search strategy used for review versions published up to 2004

We searched all records in the Cochrane Airways Group Register coded as 'COPD' for original articles published in any language using the following strategy: rehabilitat* or fitness* or exercis* or physical* or train*

In the first version of this review (Lacasse 1996), 522 publications were retrieved from the computerised search. The review authors reduced this list to 68 potentially eligible papers (quadratic weighted Kappa 0.53, 95% CI 0.45 to 0.61) that were assessed in detail. From this study list, 47 were excluded as the result of wrong population studies (n = 4), intervention not meeting the definition of rehabilitation (n = 7), control group not receiving conventional community care (n = 29), trials not randomised (n = 7). Both primary review authors agreed to include 17 papers in the meta-analysis (quadratic Kappa 0.89, 95% CI 0.65 to 1.00). Six of the 14 RCTs included in the original meta-analysis (Lacasse 1996) were not uncovered by this literature search. Therefore, a total of 23 randomised controlled trials were included. This represents an addition of nine RCTs to the meta-analysis published in 1996 (Lacasse 1996). We contacted the authors of these trials for any additional information required; response rate was 91% (21/23).

An updated search for the review was undertaken in October 2004, which identified an additional 998 references. These were filtered to a list of 139 references, which were considered in the update of the review. Of these, 93 studies failed to meet the inclusion criteria. The original version of the review as previously indicated had included 23 trials. From the updated search (2004), eight additional RCTs (represented by 17 references) met the inclusion criteria of the review (Behnke 2000a; Boxall 2005; Casaburi 2004; Chlumsky 2001; Finnerty 2001; Güell 1998; Singh 2003; Xie 2003). Six papers were awaiting assessment (Corrado 1995: published as conference abstract; Fernández 1998: paper not available; Shu 1998: published as conference abstract; Tregonning 2000: published as conference abstract; Ward 1999: published as conference abstract; Wright 2002: unclear study methods). One trial was ongoing (Whiteford 2004). As an outcome of the update in 2004, a total of 31 RCTs (represented by 65 references) contributed to the meta-analysis.

Appendix 2. Sources and search methods for the Cochrane Airways Group Specialised Register (CAGR)

Electronic searches: core databases

Database	Frequency of search
CENTRAL	Monthly
MEDLINE (Ovid)	Weekly
EMBASE (Ovid)	Weekly

(Continued)

PsycINFO (Ovid)	Monthly
CINAHL (EBSCO)	Monthly
AMED (EBSCO)	Monthly

Handsearches: core respiratory conference abstracts

Conference	Years searched
American Academy of Allergy, Asthma and Immunology (AAAAI)	2001 onwards
American Thoracic Society (ATS)	2001 onwards
Asia Pacific Society of Respirology (APSR)	2004 onwards
British Thoracic Society Winter Meeting (BTS)	2000 onwards
Chest Meeting	2003 onwards
European Respiratory Society (ERS)	1992, 1994, 2000 onwards
International Primary Care Respiratory Group Congress (IPCRG)	2002 onwards
Thoracic Society of Australia and New Zealand (TSANZ)	1999 onwards

MEDLINE search strategy used to identify trials for the CAGR

COPD search

1. Lung Diseases, Obstructive/

2. exp Pulmonary Disease, Chronic Obstructive/

3. emphysema$.mp.

4. (chronic$ adj3 bronchiti$).mp.

5. (obstruct$ adj3 (pulmonary or lung$ or airway$ or airflow$ or bronch$ or respirat$)).mp.

6. COPD.mp.

7. COAD.mp.

8. COBD.mp.

9. AECB.mp.

10. or/1-9

Filter to identify RCTs

1. exp "clinical trial [publication type]"/

2. (randomised or randomised).ab,ti.

3. placebo.ab,ti.

4. dt.fs.

5. randomly.ab,ti.

6. trial.ab,ti.

7. groups.ab,ti.

8. or/1-7

9. Animals/

10. Humans/

11. 9 not (9 and 10)

12. 8 not 11

The MEDLINE strategy and RCT filter are adapted to identify trials in other electronic databases

Appendix 3. Search strategy to identify relevant trials from the CAGR

#1 MeSH DESCRIPTOR Pulmonary Disease, Chronic Obstructive Explode All

#2 MeSH DESCRIPTOR Bronchitis, Chronic

#3 (obstruct*) near3 (pulmonary or lung* or airway* or airflow* or bronch* or respirat*)

#4 COPD:MISC1

#5 (COPD OR COAD OR COBD):TI,AB,KW

#6 #1 OR #2 OR #3 OR #4 OR #5

#7 MeSH DESCRIPTOR Rehabilitation

#8 MeSH DESCRIPTOR Respiratory Therapy

#9 rehabilitat*

#10 fitness*

#11 exercis*

#12 train*

#13 #7 or #8 or #9 or #10 or #11 or #12

#14 #6 and #13

[*Note: in search line #4, MISC1 denotes the field in which the reference has been coded for condition, in this case, COPD]*

Appendix 4. Exclusion criteria used to sort and categorise references

Exclusion criteria
Less than 90% of participants have a diagnosis of COPD
Not a programme, or programme does NOT contain any exercise component
Has an exercise component but is NOT aerobically demanding

(Continued)

Programme of less than 4 weeks' duration
Control received more than conventional care
Includes ventilated patients (hospital ventilated)
Within 4 weeks post exacerbation
This citation linked to main study paper already being screened
Duplicate citation (identical to a citation previously included)
The intervention is a medication

Appendix 5. Eligibility classification allocated to studies

Classification	Action
Excluded	Study excluded
Important article but not to be included in review	Study excluded
Included but needs translation	Study included and proceeds to next stage
Included	Study included and proceeds to next stage
More information needed before inclusion decision	Awaiting additional information before study proceeds

Appendix 6. Risk of bias domains and judgements

Sequence generation (possible selection bias)

A detailed description of the methods used to generate the allocation sequence was developed for each study to facilitate an assessment of whether it should produce comparable groups.

Risk of bias for sequence generation was graded based on the following:

- low risk (any truly random process, e.g. random number table; computer random number generator);
- high risk (any non-random process, e.g. odd or even date of birth; hospital or clinic record number); or
- unclear risk.

Allocation concealment (possible selection bias)

A description of the methods used to conceal the allocation sequence for each study was presented, and this determined whether the intervention allocation might have been anticipated in advance of, or during, recruitment, or changed after assignment.

Risk of bias associated with allocation concealment was graded as follows:

- low risk (e.g. telephone or central randomisation; consecutively numbered sealed opaque envelopes);
- high risk (open random allocation; unsealed or non-opaque envelopes, alternation; date of birth); or
- unclear risk.

Blinding of participants and personnel (possible performance bias)

The nature of the interventions involved in pulmonary rehabilitation would make it highly unlikely or impossible to blind participants or personnel delivering the interventions.

However, it would be possible to blind outcome assessors. Therefore, we assessed the risk of bias for blinding of outcome assessors as:

- high risk;
- low risk; or
- unclear risk.

Blinding of outcome assessment (checking for possible detection bias)

We will describe for each included study the methods used, if any, to blind outcome assessors from knowledge

of which intervention participants received. We will assess the risk of bias for blinding of outcome assessment as:

- low risk;
- high risk; or
- unclear risk.

Incomplete outcome data (possible attrition bias associated with withdrawals, drop-outs, deviations from original protocol)

A description of completeness of data for each outcome at all stages of the study was presented. This included examining attrition and exclusions from the analysis. Each study was examined to identify whether attrition and exclusions were reported (comparing the numbers presented at each stage with the total number of randomised participants). The studies were also examined for rationale and justifications explaining any attrition or exclusions. In instances where enough information could be identified or was obtained from the trial authors, we re-included missing data in the analyses. We assessed the risk of bias for completeness of data as follows:

- low risk (20% or less missing data);
- high risk (more than 20% missing data); or
- unclear risk.

Selective reporting bias

Studies were examined for selective outcome reporting bias by cross-checking that all outcomes identified in the methods section of the results publication were reported in the results section of the trial publication(s).

The risk of bias for selective reporting was graded as follows:

- high risk (where not all of the study's prespecified outcomes had been reported; one or more reported primary outcomes were not prespecified; outcomes of interest were reported incompletely and so cannot be used; study failed to include results of a key outcome that would have been expected to have been reported);
- low risk (where it was clear that all of the study's prespecified outcomes and all expected outcomes of interest to the review have been reported); or
- unclear risk.

Other sources of bias (bias due to problems not covered by the items above)

If the review authors believed that any other possible sources of bias were matters of concern, these were recorded.

The level at which studies were seen to be free of other problems that could put them at risk of bias was graded as:

- low risk;
- high risk; or
- unclear risk.

Overall risk of bias

An overall judgement was made in relation to whether studies were at high risk of bias, according to the criteria given in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011) and identified above. The magnitude of the overall bias, along with the degree to which the bias was likely to have impacted the findings, was assessed for each study using the following grades:

- low risk;
- high risk; or
- unclear risk.

WHAT'S NEW

Date	Event	Description
21 April 2015	Amended	Typo in CI for functional exercise capacity in results corrected.

HISTORY

Protocol first published: Issue 1, 1998
Review first published: Issue 1, 2003

Date	Event	Description
26 March 2014	New citation required and conclusions have changed	New author team Abstract, plain language summary and results redrafted. Inclusion criteria modified and outcomes defined. Methods brought up to date, including use of current Cochrane risk of bias tool. Summary of findings table added Conclusions strengthened through the addition of 35 new studies, and recommendations for future research modified Only assessments completed up to and within 3 months of completion of the intervention included in the analysis Studies that commenced within 4 weeks of an acute exacerbation of COPD excluded, as a separate systematic review examined the effects of pulmonary rehabilitation following exacerbations of chronic obstructive pulmonary disease (Puhan 2011) Additional subgroup analysis undertaken
26 March 2014	New search has been performed	New literature search run
20 August 2008	Amended	Converted to new review format
16 June 2006	New citation required and conclusions have changed	Substantive amendments made

CONTRIBUTIONS OF AUTHORS

BMC and DC selected trials.
BMC, DC, EM and KM extracted data.
BMC, DC, EM, DD and KM assessed the methodological quality of trials.
BMC was responsible for handling data in RevMan.
BMC and DD designed the meta-analysis.
BMC and DD completed the clinical interpretation of results.
YL provided support and guidance throughout the update and critically reviewed the final manuscript.

DECLARATIONS OF INTEREST

The review authors DC, BMC, KM and DD were involved in the PRINCE study conducted by Casey 2013, a cluster-randomised trial that was included in this review. The risk of bias table for this study was therefore completed by two independent review authors, who were not involved in this trial but were experienced in conducting Cochrane systematic reviews. These were the review authors EM and Miriam Brennan, Lecturer at the School of Nursing & Midwifery, NUI Galway.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

In this current update, the following changes were made from the previous version.

- We made the following changes to the inclusion and exclusion criteria.
  - We excluded randomised controlled trials that focused on participants:
    - who were ventilated; or
    - who had an acute exacerbation within four weeks before commencement of the intervention
  - We excluded interventions for which the physical activity component was considered to not be aerobically demanding (such as respiratory muscle training, breathing exercises, Tai Chi and yoga). The degree of aerobic demand was assessed for each individual intervention by examining the detailed description of the intervention in identified studies. We also excluded programmes of less than four weeks' duration.
- We clarified what was considered usual care.

INDEX TERMS

Medical Subject Headings (MeSH)

*Exercise Tolerance; *Health Status; *Quality of Life; Dyspnea [rehabilitation]; Pulmonary Disease, Chronic Obstructive [psychology] [*rehabilitation]; Randomized Controlled Trials as Topic

MeSH check words

Female; Humans; Male